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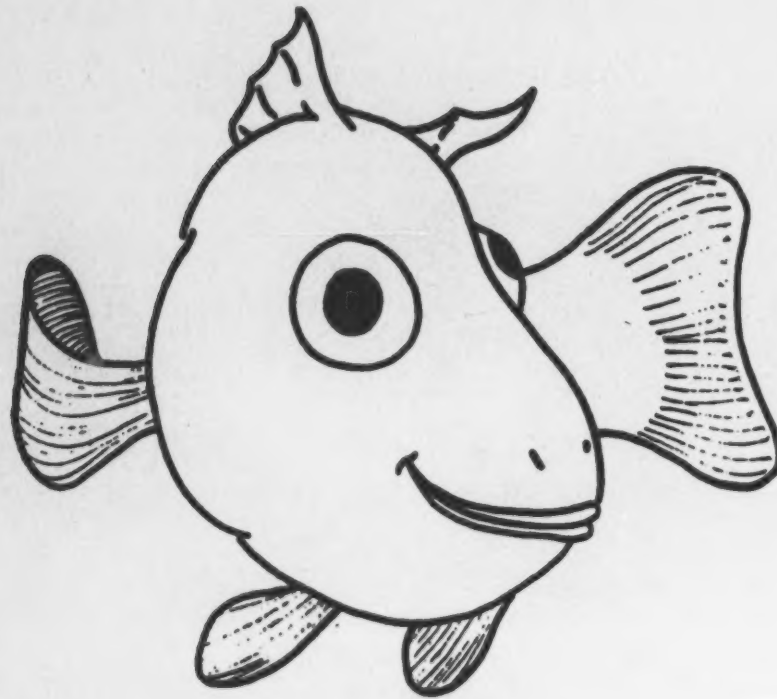
ABSTRACT

This curriculum plan is submitted as a framework for developing educational programs at the Columbus Zoo Aquarium (CZA) for elementary school students in grades 3 through 6. It is intended to provide support and assistance to those involved with CZA programs. Major sections include: (1) "Review of Columbus Zoo's Educational Programs"; (2) "Identification of Educational Planning Needs" (including benefits of the aquarium); (3) "Educational Rationale and Philosophy for the Columbus Zoo Aquarium"; (4) "Goals and Objectives for Education at the Columbus Zoo Aquarium" (describing a four-level hierarchy of goals for environmental education curricula); (5) "Factors to Remember in Columbus Zoo Aquarium Educational Planning"; (6) "Audience Characteristics and Educational Needs"; (7) "Program Implementation Strategies"; (8) "Proposed Programs for Implementation" (providing four program units with audience, goals, objectives, a unit outline, and a field trip outline); (9) "Program Implementation Review"; (10) "Teacher Workshops"; and (11) "Program Evaluation" (including parameters for formative and summative evaluation). There are 112 references listed. (YP)

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A Curriculum Plan for the Columbus Zoo Aquarium Grades 3 through 6



by
Brian Alsdorf
December 1988



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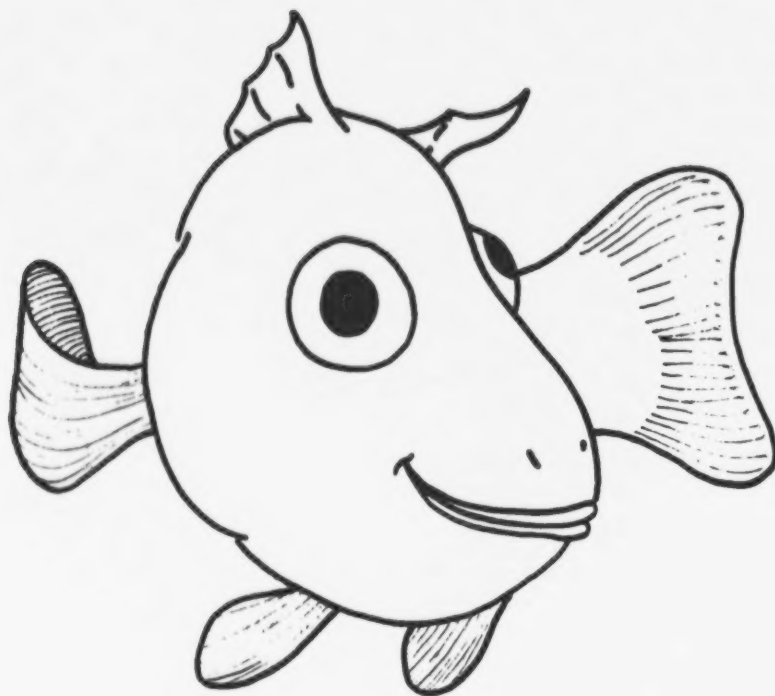
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December, 1988

An independent study submitted in partial completion of
requirements for the Master of Science degree in
Natural Resources / Environmental Education,

Dr. Robert E. Roth, Advisor.

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Columbus Zoo's Mission Statement

An organization's mission statement provides its members with a sense of cause and direction. It is an expression of foundation goals for which the organization exists. Columbus Zoo's mission statement can be summed up in four words; conservation, education, research, and recreation.

In some of its publications the Columbus Zoo offers this perspective of its mission:

"One of the fastest-growing zoos in the country, (the Columbus Zoo) has a deep commitment not only to conservation of animals, but also to education of the public, to research in wild animal propagation and management, and as a recreation site for Central Ohioans and visitors to the area."

A dedication plaque in the zoo's education building bears this inscription clarifying the educational goal:

"Columbus Zoo Educational Interpretive Facility"

"Because the vast majority of zoo animals are representatives of declining species, the highest priorities in zoo education should clearly be given over to wildlife conservation."

"December 1980"

Introduction

The Columbus Zoo Aquarium (CZA) is currently being renovated. A proposal to develop CZA into a premier aquarium within five years is now being considered by Columbus Zoo's Board of Trustees and Executives. Doug Warmolts, newly appointed Aquarium Curator, hopes the proposal will be approved. If so, he anticipates CZA will attract more visitors to the Zoo on a year-round basis and the opportunity to more fully meet the Zoo's four part mission will exist. In addressing this mission, his desire is to develop appropriate programs and necessary support facilities.

Some plans for facility construction have already been drawn. Program planning however remains as formative ideas in the minds of those associated with the project. As needs justify programs which in turn justify facilities, it is imperative that these ideas be documented and discussed. Before further effort in facility planning is made, an assessment of needs should be conducted. Then, based on perceived needs, educational and interpretive programs can be put in place. At that point, the concrete could be poured. Columbus Zoo's mission statement is the focus for this process.

This curriculum plan is submitted as a framework for developing educational programs at CZA for elementary school students in grades 3 through 6. It is intended to provide support and assistance to those involved with CZA programs. While conceptual in nature, this plan: (1) outlines a basis for education at CZA; (2) lists specific goals and objectives; (3) suggests strategies; and (4) details possible evaluative criteria.

Review of Columbus Zoo's Educational Programs

In respect to its mission, the Columbus Zoo is deeply committed to public education. A dedicated staff of five full-time educators supervises many part-time and seasonal educators who together, present a multitude of programs. A weekly preschool offers insights on animals to 3, 4, and 5 year olds. On Saturdays, 3 to 12 year olds are presented with a program about the Zoo's operation and a special art class is available for youth, 10 to 14 years of age. Many youth groups participate in an overnight opportunity to discover animals after closing hours. During the summer, a day camp is operated for children from 4 to 13 years of age. Informal lectures on specific topics for adults and families are scheduled periodically.

For schools and other groups, the Education Department sponsors outreach programs and in-house "Creature Features." Their outreach program takes animals, artifacts, and support materials to classes for 45 minute discussions of either Adaption, Textures, Avian Antics, or Birds of Prey. "Creature Features," presented

in an auditorium, explores various animal characteristics or issues involving endangered species through the use of live animals, artifacts, and audio-visual media utilizing a 30 minute time span. Most interest for these programs is expressed by elementary schools. These programs are currently being expanded to create more topic areas for presentation. The Education Department tries to cater to special interest groups by arranging talks about professional careers at the Zoo or about other subjects on an "as needed" basis.

A project to which they are presently committed involves audiences with special needs. Having received a Columbus Foundation grant, the Education Department is working to develop an appropriate program for handicapped groups. A part-time educator has been employed to facilitate this.

This general review of programs illustrates the diversity and broad scope of Columbus Zoo's efforts in public education. These programs were started several years ago. A clientele has developed and participation in them is high. As demand can certainly be one indication of a program's success, this is an excellent compliment for the work the Education Department is doing.

Identification of Educational Planning Needs

In developing new programs for use at CZA it would be convenient and well advised to begin with the same foundation utilized by those successful programs already being implemented at the Zoo. However, this is not as easy as it would appear. Each of their current programs is an entity by itself and stands alone. There is no documentation of common bonds which unite them. Although the individuals who teach these programs could provide a list of objectives they want to achieve in their presentations, there is no formal written statement of the Zoo's overall educational goals or objectives. The Zoo does not seem to have a central management message or any common themes it wishes to express. The education building dedication plaque's directive to give priority to wildlife conservation in zoo education it seems is heeded only when it fits into an individual program's content.

The logic behind this is difficult to unravel. Apparently, beyond the statement that the Zoo "...has a deep commitment...to education of the public..." all other guidance for educational programs is somewhat speculative. How would the Zoo determine appropriateness of new programs? How does the Zoo evaluate its programs already in place? From what basis do they establish their educational position? Questions like these involve the rationale and philosophy behind an educational mission. Answers to such questions are part of the continuing process of planning.

The problem in producing new programs for use at CZA exists because the Zoo has overlooked definition of its educational planning efforts. Although this is a common oversight, there is reason to be concerned, as Young (no date) points out:

"The heart of this subject is really policy planning and the procedures involved in converting broad policy into definitive and unquestionable guidelines. It involves the determination of what we want to do before we decide how to do it. If this seems like the usual way of doing things, a few moments of reflection will certainly bring to mind a number of things we are doing as a nation simply because we can do them." "Precisely because our technology and wealth have made so many more things technically and economically possible, it becomes more important to decide why we want to do them or if, indeed, we want to do them at all. Nowadays, we can get what we do not want with great ease and efficiency. This is a somewhat new condition in civilization—previously, a great deal of struggle was involved in making any kind of change."

"...very little thought appears to have been given to the problem of setting goals; those that were more or less pursued by various programs had not only been around for a long time but were poorly defined." "But the day is over when one can plan for a traditional market. New concepts of social and economic equity, new realizations of the importance of social dynamics and, of course, the much vaunted increase in leisure and wealth mean that a whole new set of factors have to be cranked into planning considerations."

Young (n.d.) makes several poignant statements. The Zoo's mission statement is its broadest policy. This policy needs to be converted into guidelines which clearly define what the Zoo intends to do to meet its mission. Why is the Zoo interested in expanding its aquarium? How will this aquarium help support zoo policies? In a proposal for aquarium improvements (Warmolts 1988), the following list of benefits is included:

Benefits of the Aquarium

- Aquariums have a proven track record of popularity and for generating income.
- Increase zoo attendance.
- Attract more tourists from outside of the local area.
- Year round attraction.
- Completion of the five year plan in conjunction with the Sea Mammal Exhibit will warrant an admissions increase.
- Associated profit-making venture such as a gift shop, book store, and restaurant could generate additional income.
- Stronger emphasis placed on the education of our "water planet."
- Serve as a hub for aquatic research.

The nature of most predicted benefits resulting from aquarium improvement is logistical. However, the last two items suggest concern for the Zoo's educational and research endeavors. Still, further explanation is needed to bridge gaps between how an expanded aquarium is consistent with Zoo policy. What is meant by "education of our 'water planet'"? Why is the Zoo concerned with this type of education? What kinds of aquatic research will be conducted? Will it be "research in wild animal propagation and management," as the Zoo's publications suggest?

The proposal cited previously, is a preliminary outline of short and long term projects at the aquarium which are being considered for approval. If approved, the importance of planning all facets of these projects is paramount. The concept of determining "what we want to do before we decide how to do it," is easy to forget.

Young (n.d.) also, advises that goals should be developed for programs designed to meet the needs of a new market. Present Zoo programs have, "been around for a long time," their goals are "poorly defined," and "...a whole new set of factors have to be cranked into planning considerations," (Ibid.). Future program planning at the Zoo should be carefully investigated and clearly defined. Goals with attainable and measurable objectives must be set for the Zoo's overall mission, for its educational mission and for each subset of its education effort. Future program offerings must be held accountable to their respective objectives. Strategies for reaching these objectives should be detailed. In all of this, evaluation should be an ongoing part of the process and a summative process. Only through this, can a program's success be adequately determined and analyzed.

People who form this plan should be receptive to changing it. They must realize guesswork and unsubstantiated opinions have no place in planning. Planners must also avoid preordained convictions toward particular actions. On preparing a plan, Sharpe (1982: 77) mentions the importance of structure, research, and the need for advance statements of goals and objectives:

"The first is that planning is a process. There are logical and sequential steps in this process; and it is continuing and ongoing. Therefore in the development of a plan, it is important that it not be viewed as an end in itself. A plan is a dynamic tool. Because of new information, changing social attitudes and values, new technology, and new ways of approaching problems, it is imperative that a plan be flexible enough to respond to and reflect such changes. It must always be open to comment and revision and must not be a static document cast in concrete."

"The decisions that are made in the development of a plan are based on reason. They are a conscious attempt, using the best available information, to substantiate and justify particular courses of action. To make planning decisions based purely on intuition, especially today when planning efforts are under such close scrutiny, would be the height of folly."

"Planning is also concerned with future courses of action as a means of achieving established goals and objectives. Therefore, the rational planning

process is in advance of action. To develop a plan to justify actions already taken is not planning. Also, the future courses of action must have a direction as indicated by the fact that we are attempting to achieve certain goals and objectives. Unless the goals are clearly defined in advance and readily understood by those affected, it is impossible to know whether or not the planning effort is successful or will be well received. Therefore, measurable goals and objectives must be established."

It may seem unnecessary to document this rationale, but in as much as the written word is proof of yesterday's thoughts, there is reason enough to do so. Sharpe (Ibid.) points out, it is essential to establish and define goals before action is taken in order to decide the success of those actions. Verbal agreement of goals in educational planning is not enough. With staff changes, program modifications, and differences in perception, it is easy to lose sight of those original program goals. If goals are not recorded, it becomes more convenient to change them rather than change the program to meet them. Furthermore, Young's (n.d.) comments about change and new concepts of social and economic equity could be viewed in light of their influence on an organization's budget. The ability to show written evidence of a program's success, in terms of objectives achieved as opposed to just the number of people who came, could be crucial when funding is appropriated. After all, many attractions at the Zoo can claim attendance figures as marks of success, including tigers, tulips, and beer gardens. The ability to focus on the importance of education at the Zoo might mean its right to exist.

The need for documentation defining the Zoo's educational mission and how it plans to meet this mission has been identified. While the job of preparing such a document is beyond the scope of this project, without such a plan, preparation of this proposed curriculum must be based on some speculation. However, the writer has been employed as a part-time educator at the Zoo for nearly two years and is familiar with the Zoo's educational programs. Based on this experience and general similarities in program planning for nonformal educational settings, the writer suggests this curriculum to be consistent with the Zoo's educational mission.

As the aquarium is one component of the entire Zoo, so too are its educational aims. Education at CZA must support the Zoo's educational goals, but the themes and content should be restricted to topics appropriate for an aquarium. The scope of this curriculum plan therefore includes:

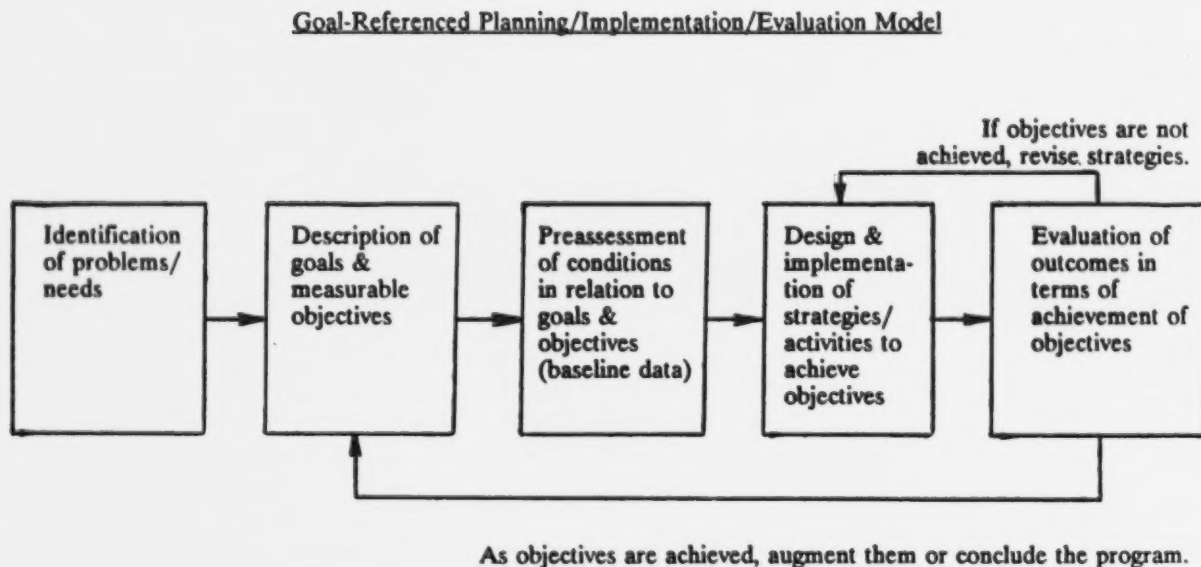
1. Development of a rationale and philosophy for educational programs at CZA.
2. Definition of goals and objectives which compliment this philosophy.
3. Identification of appropriate educational themes, topics, and activities for elementary school students in grades 3 through 6.
4. Provision of a basis for evaluating implementation of educational programs.
5. Establishment of a foundation for the needed facilities to support these programs.

A Goal-Referenced Planning/Implementation/Evaluation Model (Rocchio and Lee 1974: 35) was used in preparation of this curriculum plan. The model's authors explain:

"The system begins with the collection and study of data concerning the problems and needs. This information is translated into general goals, which are then spelled out in terms of measurable objectives or outcomes expected to be attained. Strategies are developed to achieve these objectives. Built-in, program specific evaluation instruments and measurement techniques are employed to provide (1) continuous assessment of progress, (2) a feedback mechanism for self-correcting improvement, and (3) comparison of objectives achievement with the baseline data."

"This systematic process insures that the functions of planning, implementation, and evaluation become an integrated operating structure leading to successful achievement of program goals. A simple schematic representation appears in the following [Figure 1.]:"

Figure 1.



Ref.: Rocchio, R. and E. Lee (1974) *On Being a Master Planner* ERIC/SMEAC, Columbus, OH :35.

Educational Rationale and Philosophy for the Columbus Zoo Aquarium

The Columbus Zoo Aquarium (CZA) is home to aquatic life originally imported from natural environments. Visitors to CZA have an opportunity to develop a keener awareness, appreciation, and understanding of the natural diversity of aquatic life. Education can help the visitor to know more about what is displayed in the Aquarium and perhaps help to increase the visitor's appreciation for the aquatic life displayed. But, education does not need to be limited to the aquatic displays contained within the Aquarium. Although education at CZA should focus on the Aquarium's inhabitants, it should also strive to help the visitor develop a keener awareness, appreciation, and understanding of the environments where the Aquarium's occupants are naturally found.

There are many issues which affect these environments today. Indeed, if one espouses a "global ethic", then these issues affect all of us. Engleson, et al. (1985: 3) states:

"Such an ethic assumes that all persons present and future are entitled to equal respect and a share of the benefits of the environment, and that nature's processes and life support systems are entitled to the same careful respect when used for the achievement of a higher quality of life. Such an ethic is incompatible with value orientations which regard persons and natural resources as things to be exploited simply for the gratification of certain human beings at the expense of other human beings and living things."

"Developing a global ethic will not be an easy task. Governments and policy makers can and may order changes, and new approaches to development can and may begin to improve the world's condition—but these are no more than short-term solutions unless the youth of the world are educated with such an ethic in mind. This kind of education has come to be called environmental education."

This curriculum plan is based on the belief that education at CZA is firmly rooted in the rationale of a global environmental ethic. CZA's role in the development of a global environmental ethic is to act as a community resource where visitors will discover they are a part of, not apart from, the earth's biosphere. A philosophy which guides the development of a global environmental ethic is that:

"The quality of the environment and the quality of life for the inhabitants of planet Earth are directly related. The human inhabitants of Earth have the power to control the quality of the environment. Too frequently the use of this power has a negative environmental impact, often to the point of irreversibility. Thus the defense and improvement of the environment on behalf of present and future generations of all living things has become an imperative goal for all human beings. Every citizen of planet Earth must accept responsibility for this goal and become an active participant in working toward its achievement."

"Society prepares its citizens to carry out their responsibilities through its system of education. Education must work to help each citizen develop an

awareness of and a sensitivity to the environment and its problems. Furthermore, education must help each citizen acquire the knowledge and understanding needed to perform effectively. And, education must foster positive attitudes and patterns of conduct toward the environment. This is the role of environmental education," (Ibid).

In accepting a global environmental ethic and the philosophy behind it, education at CZA is clearly aligned with environmental education. The Aquarium's educational programs stress the importance habitat has on aquatic life, and in turn, on all of us and what we must know and do to improve the quality of aquatic environments, and how our attitudes and actions influence the resolution of issues affecting aquatic environments. These programs encourage participants to consider today's actions in terms of tomorrow's consequences and to "act locally, but think globally."

Goals and Objectives for Education at the Columbus Zoo Aquarium

Education at the Columbus Zoo Aquarium (CZA) is in practice, environmental education. This fact facilitates the adoption of environmental education's goals and objectives.

"Goals are general statements of desired conditions to be sought in the future. There is no specific time frame associated with a goal and the future may be immediate or distant. Because of the lack of a specific time frame for attainment, goals have no measurable components. Goals infer a course of action, state an overall purpose, provide a definite target that reflects the overall purpose whose attainment appears to be feasible; but do not define the actions that must be taken. Goals provide the basis for development of specific statements of what to do and when to do it that are called objectives. Objectives translate the generalities of goals into specific measurable and attainable activities and results," (Roth, 1987: 2).

"Without a clear statement of goals, a program would become a series of unrelated experiences, focusing on limited program objectives," (Stapp, 1974).

A definition of education often serves as a curriculum's overall goal. Disinger (1985) has reviewed literature pertaining to environmental education and suggests:

"A number of apparently viable definitions and models have been advanced; Harvey [1977] has provided an analysis of most of them, and proposed a middle ground."

This curriculum plan is developed on the premise that CZA accepts Harvey's (1977) definition of environmental education as its superordinate goal in education as stated in the context of "Goals for Curriculum Development in Environmental Education" (Hungerford, et al. 1980):

"The Superordinate goal...to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment."

Hungerford, et al. (1980) used this definition in preparing an outline of goals for environmental education curricula. The goals listed in this outline and "The categories of environmental education objectives" proposed in the Tbilisi Declaration (1977) are considered to be valid for CZA Education in designing this curriculum plan.

The Tbilisi Declaration divides environmental education into these categories:

- Awareness:** to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
- Knowledge:** to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.
- Attitudes:** to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection.
- Skills:** to help social groups and individuals acquire skills for identifying and solving environmental problems.
- Participation:** to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

Hungerford, et al. (1980) propose a four level hierarchy of goals for environmental education curricula:

Level I. Ecological Foundations Level

This level seeks to provide the receiver with sufficient ecological foundations knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.

The Ecological Foundations Level would minimally include the following conceptual components:

- A. Individuals and populations.
- B. Interactions and interdependence.
- C. Environmental influences and limiting factors.
- D. Energy flow and materials cycling (biogeochemical cycling).
- E. The community and ecosystem concepts.
- F. Homeostasis.
- G. Succession.
- H. Man as an ecosystem component.
- I. The ecological implications of man's activities and his communities.

Level II. Conceptual Awareness Level—Issues and Values

This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment and also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action.

Goals at this level are formulated to provide opportunities for receivers to conceptualize:

- A. how man's cultural activities (e.g., religious, economic, political, social, etc.) influence the environment from an ecological perspective.
- B. how individual behaviors impact on the environment from an ecological perspective.
- C. a wide variety of environmental issues and the ecological and cultural implications of these issues.
- D. the viable alternative solutions available for remediating discrete environmental issues and the ecological and cultural implications of these alternative solutions.
- E. the need for environmental issue investigation and evaluation as a prerequisite to sound decision making.
- F. the roles played by differing human values in environmental issues and the need for personal values clarification as an integral part of environmental decision making.
- G. the need for responsible citizenship action (e.g., persuasion, consumerism, legal action, political action, ecomanagement) in the remediation of environmental issues.

Level III. Investigation and Evaluation Level

This level provides for the development of the knowledge and skills necessary to permit receivers to investigate environmental issues and evaluate alternative solutions for remediating these issues. Similarly, values are clarified with respect to these issues and alternative solutions. Goals at this level are presented in two components.

Component A: Goals for component A are to develop in receivers:

- A. the knowledge and skills needed to identify and investigate issues (using both primary and secondary sources of information) and to synthesize the data gathered.
- B. the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications.
- C. the ability to identify alternative solutions for discrete issues and the value perspectives associated with these solutions
- D. the ability to autonomously evaluate alternative solutions and associated value perspectives for discrete environmental issues with respect to their cultural and ecological implications.
- E. the ability to identify and clarify their own value positions related to discrete environmental issues and their associated solutions.
- F. the ability to evaluate, clarify, and change their own values positions in light of new information.

Component B: Goals for Component B are to provide receivers with opportunities to:

- G. participate in environmental issue investigation and evaluation.
- H. participate in the valuing process in a manner as to permit the receiver to evaluate the extent to which his/her values are consistent with the superordinate goal of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Level IV. Environmental Action Skills Level— Training and Application

This level seeks to guide the development of those skills necessary for receivers to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment. Goals at this level are presented in two components.

Component A: The goal for component A is to develop in receivers:

- A. those skills which will permit them to effectively work toward ends which are consistent with their values and take either individual or group action when appropriate, i.e., persuasion, consumerism, political action, legal action, or ecomanagement.

Component B: The goals for Component B are to provide receivers with opportunities to:

- B. make decisions concerning environmental action strategies to be used with respect to particular environmental issues.
- C. apply environmental action skills to specific issues, i.e., to take citizen action on one or more issues.
- D. evaluate the actions taken with respect to their influence on achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment.

The range of these goals is quite broad. It will require a large number of programs to adequately address all of these goals. In time, CZA may realize a need to provide the many programs necessary to approach these goals but having these goals already in place should facilitate and provide direction for future program planning at CZA. Also, by having these goals established it is possible to gain some perspective of how an individual program fits into the total scheme of CZA's educational effort.

The researchers who compiled these goals were dedicated to advancing a complete environmental education curriculum. As environmental education is an ongoing process throughout a persons entire life, these goals represent a sort of "womb to tomb" approach. Through their work, (Hungerford, et al. 1980):

"...the researchers infer a substantial degree of content validity for the goals as written."

Because these goals cover so many aspects of environmental education, an educator interested in developing a program should assess the audience's needs and then build a program around a framework of selected goals.

Identifying audience needs is crucial to program success. Minimally, it involves understanding intellectual development stages, brain growth periods, and current status of audiences advancement in terms of environmental education.

"Environmental education programs should conform to known growth patterns of students. The fulfillment of human growth needs of students should never be subordinated to the fulfillment of societal needs or the demands of disciplines," (Engleson, et al. 1985: 6).

A general indication of emphasis for environmental education programs based on a visitor's grade level in school is provided in Table 1. In reviewing Table 1., it is possible to gain an idea of universal environmental education objective categories upon which CZA's educational programs should focus on for school age audiences. These category areas, as detailed previously, provide an overall view of environmental education. However, because they lack specificity, these objective categories have resulted in...

"...inherent difficulties confronting a curriculum developer charged with the task of translating what are actually general goals (e.g., to develop environmental awareness, knowledge, attitudes, skills, etc.) into manageable instructional objectives. The difficulties inherent in translating the general goals into instructional objectives have...resulted in the use of "hunches" as a basis for curriculum planning," (Hungerford, et al. 1980).

Table 1.
Grade-Level Emphases on Environmental Education
Objective Categories

<u>Level</u>	<u>Major Emphasis</u>	<u>Minor Emphasis</u>
K-3	Awareness Attitudes	Knowledge Skills Participation
3-6	Knowledge Attitudes	Awareness Skills Participation
6-9	Knowledge Skills Attitudes	Awareness Participation
9-12	Skills Participation Attitudes	Awareness Knowledge

Ref.: Engleson, D. C. et al. (1985) A Guide to Curriculum Planning in Environmental Education. Wisconsin Dept. Public Instruction, Madison, WI :9.

The purpose of the four level hierarchy of goals, detailed previously, is to bridge gaps between the general goals (objective categories) of environmental education and instructional objectives. After the audience and its major emphasis categories have been identified, specific goals may be correlated for a program from the following, Table 2:

Table 2.

A Comparison of the Goals for Curriculum Development in Environmental Education to the Tbilisi Conference Categories of Objectives

Tbilisi Objectives					Developers' EE Curriculum Goals By Level	
Awareness	Knowledge	Attitudes	Skills	Participation		
1	2	3	4	5		
X	X				Level I. Ecological Foundations Level	
					All Subcomponents (A-I)	
					Level II. Conceptual Awareness Level	
					Subcomponent:	
X	X					A
X	X					B
X	X					C
X	X					D
X	X	X				E
X	X	X				F
X	X	X				G
					Level III. Investigation and Evaluation Level	
					Subcomponent:	
X	X		X			A
X	X		X			B
X	X		X			C
X	X		X			D
X		X	X			E
X	X	X	X			F
X	X	X	X	X		G
X		X				H
					Level IV. Action Skills Level	
					Subcomponent	
			X			A
			X	X		B
			X			C
			X			D

Ref.: Hungerford, H. et al (1980) Goals for Curriculum Developers in Environmental Education, Journal of Environmental Education 11(3): 42-47.

Following the selection of specific program goals, instructional objectives can then be developed. As each program will have different goals, it is beyond the scope of this plan to present instructional objectives for all possible programs, however, the method used in this plan to construct instructional objectives is suggested to serve as a useful mode.

Factors to Remember in Columbus Zoo Aquarium Educational Planning

An educator involved in constructing a program at the Columbus Zoo Aquarium (CZA) should know:

"That ecological foundations are critical to any EE [environmental education] program as prerequisite or corequisite cognitive knowledge. That ecological concepts are an integral part of EE. Despite this premise, it remains cogent to make certain that receivers distinguish between environmental education and ecology per se," (Hungerford, et al. 1980).

Additionally, the educator should keep in mind that different methods of instruction must be consistent with CZA's educational goals. Programs at CZA involve, environmental sensitivity on the part of the visitor and, the process of values clarification and moral reasoning. It is important to develop programs that rationally assess both cultural and ecological costs involved in resolution of issues to achieve a dynamic equilibrium. This may compromise qualities of life and/or environment. Educators should not force visitors to take action, but should provide an opportunity to act. Educators must realize that education at CZA is interdisciplinary and multidisciplinary in scope.

Education at CZA involves aquatic environments with respect to the total environment, including natural and human created environments. In presenting issues CZA education strives to illustrate a variety of viewpoints, from different levels and from different geographic orientations, to enable visitors to gain a variety of perceptions of these issues. Today's and tomorrow's environmental concerns are discussed in CZA education with reference to yesterday's circumstances. Education at CZA should recognize the complexity of environmental issues and require visitors to develop critical thinking and problem solving skills.

Through its educational programs CZA will:

"Promote the value and necessity of local, national and international cooperation in the prevention and solution of environmental problems."

"Help learners discover the symptoms and real causes of environmental problems," (Tbilisi Declaration 1977).

Other factors which will help the educator in planning programs are from a review of literature by Stapp and Vande Visse (1975) as follows:

"A recent review of the literature regarding theories of learning and instruction reveals the following points that should be considered in the formulation of any environmental education program."

- Behaviors which are reinforced are most likely to recur. It is important that desired behaviors be reinforced by the home, school, church, youth organizations, etc.
- The most effective effort is put forth by youth when they try tasks which fall in the "range of challenge" —not too easy and not too hard— where success seems likely but not certain.
- Youth are more likely to throw themselves wholeheartedly into any project if they themselves have a meaningful role in the selection and planning of the enterprise.
- Reaction to excessive direction of the teacher is likely to be apathetic conformity, defiance, and escape from the whole affair.
- Knowledge developed in the context of an issue or investigation is utilized more often and retained longer than facts memorized to complete a subject area. The practice of teaching predigested subjects thought to be needed when students are adults yields low retention and attention.
- The learning process in school should involve dynamic methods of inquiry.
- Learning takes place through the active behavior of the student. It is what he does that he learns, not what the teacher does. The essential means of an education are the experiences provided, not the things to which the student merely exposed.
- One of the keys to motivation is a sense of excitement about discovering for one's self, rather than having a generalization presented by a teacher and requiring a student to prove it.
- Attitudes may not be formed through a rational process by which facts are gathered and a reasonable conclusion drawn, but rather through the repeated exposure to ideas.
- Helping citizens to acquire technical knowledge alone regarding an environmental problem may not increase their concern for the problem.
- Citizens are more likely to become involved in environmental issues if they are aware of how they can have some effect upon decision making.
- In conclusion, learning theory and research confirm the validity of curriculum with real-issue involvement and problem-solving emphasis. This kind of environmental education, based on the above, requires deliberate reorganization of curriculum and teaching methods.

The above factors are provided as guidelines to consider when developing educational programs at CZA.

Certainly, there are many more concepts, not detailed here, which an educator should also take into account. The intent for including these factors is to highlight the more pertinent concepts and to spark ideas necessary in the planning process.

Audience Characteristics and Educational Needs

This curriculum plan is designed to be implemented with students in grades 3 through 6 from the Columbus Public School System. Under the Ohio Revised Code, students in this school system must experience

environmental education according to the provisions of the law. To insure that education is in accordance with all applicable statutes, the Columbus Public School System publishes an official graded *Course of Study* (White, et al. 1985). According to the authors (Ibid.):

"It serves as the common and basic structural framework for the development of instructional programs. It is an outline of the subject-area content, organized to show the agreed-upon sequential progression of skills, concepts, facts, and generalizations to be taught and values and attitudes to be developed in a given subject or area of study for a particular grade. It is intended to help staff members become informed about the district's expectations regarding educational programs and course content."

The philosophy which guides education in this School District is consistent with the educational philosophy and goals of the Columbus Zoo Aquarium (CZA) in that both are clearly committed to helping citizens become responsible participants in our society. To illustrate other common parallels between aims of these organizations the following excerpts from the Districts "Philosophy of Education" (White, et al. 1985) are provided:

"The primary concern of public education is, and must continue to be, students. Public education must also continually reaffirm its commitment to help the student and society achieve broad goals. The Columbus Public schools believe this commitment can best be realized through:

- goals and objectives that clearly and explicitly define the form, content, scope and sequence of educational offerings;
- opportunities for learning which help students become effective human beings - inquiring and knowledgeable, rational and logical, self-understanding and self-accepting, healthy and strong, responsible and competent, compassionate and just.

Our schools should help students to:

- ...learn how to examine and use information;
- ...learn and understand the changes that take place in the world;
- ...appreciate culture and beauty in the world;
- ...develop critical thinking skills;
- ...learn to respect and get along with all people;
- ...learn how to be a good citizen in a democratic society;

Principles which Columbus Schools' teach are very concurrent with those of education at CZA. Educational programs at CZA and Columbus Schools are founded on similar doctrine and strive to achieve similar goals. This indicates that CZA may be able to facilitate the needs of the District by providing programs which compliment those detailed in the *Course of Study* (Ibid.).

To graduate from Columbus Schools, a student must satisfy the requirements found in the *Course of Study* (Ibid.). A student wishing to graduate would regard these requirements as needs (i.e., I need to pass the requirements for math, English, science, etc. to graduate). Therefore, by offering programs at CZA which are consistent with the *Course of Study* (Ibid.), CZA is accurately addressing the needs of students enrolled in the Columbus Public School System.

To further assess this audiences needs, an educator should be familiar with human growth and development patterns. In the following paragraphs, Table 3., and Figure 2., pertinent research to this regard is summarized by Engleson, et al. (1985):

"Research regarding intellectual, moral, and ethical development provides a basis for the consideration of human growth and development in structuring environmental education programs. The contributions of Jean Piaget and Patricia Arlin in the area of intellectual development, and of Herman Epstein and Conrad Toepfer, Jr., in the area of brain growth periodization are especially useful in this regard. The results of the work of Piaget and Arlin are summarized in [Table 3]."

"The results of the work of Epstein and Toepfer can be summarized as follows."

- The brain grows in a stagewise fashion, with spurts occurring for most children between the ages of 3-10 months, 2-4 years, 6-8 years, 10-12 years, and 14-16+ years.
- Plateaus in brain growth occur between the ages of 10 months-2 years, 4-6 years, 8-10 years, and 12-14 years.
- The first four brain growth stages coincide with the onset of the classic Piagetian stages. The last brain growth stage coincides with the fifth Piagetian stage identified by Arlin.
- During brain growth periods, new facts and information can be learned when attached to the learning of appropriate new and higher level thinking skills.
- During plateau periods, new facts and information can be learned by utilizing the skills initiated during previous brain growth periods, thus aiding in the maturation of these new skills before progressing to another new, higher skill level.
- In some children, brain growth periods are short relative to those of other children; therefore, plateau periods also vary in length.
- Growth periods and plateaus do not occur in all children at the same time; therefore, it is important to identify when they occur in individuals in order to plan responsive learning environments during these stages.

"The correlation between Piaget's stages and Epstein's and Toepfer's brain growth periods is portrayed in [Figure 2.], which shows the relationship between the classical Piagetian stages and the brain growth spurts discovered by Epstein and Toepfer. An additional element of [Figure 2.] is the relationship between the work of Piaget, Epstein and Toepfer and the usual grade level for individuals of certain age."

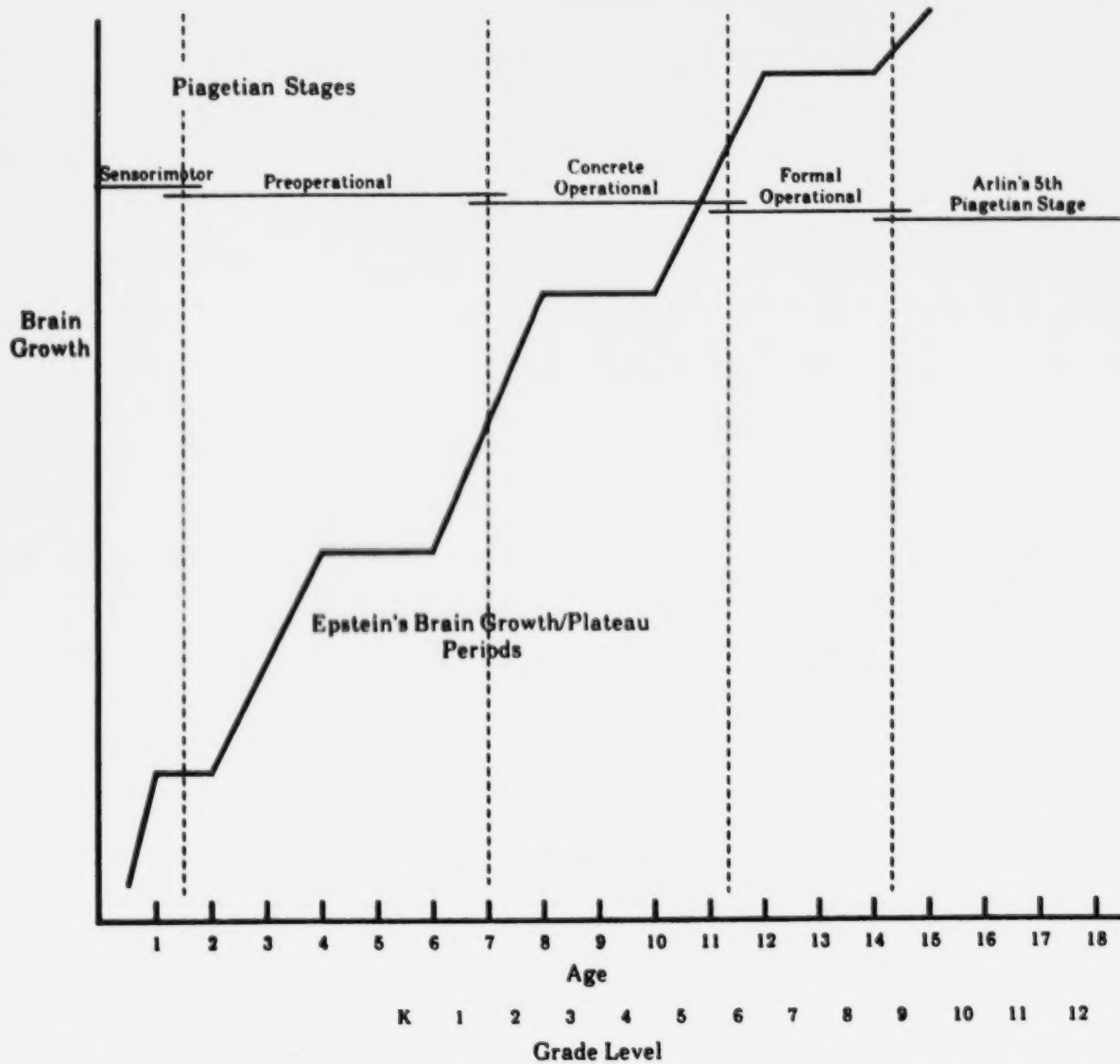
Table 3.
Piagetian Intellectual Development Stages

Developmental Stage	General Age Range	Characteristics of Children
Sensorimotor	Birth to approximately 18 months	— Preverbal — Objects exist only when in the perceptual field of the child — Hidden objects are located only through random physical search — Practical basic knowledge develops which forms a substructure for later representational knowledge
Preoperational	18 months to 7-8 years	— Organized language and symbolic function begins, thought and representation develop — Perceptually oriented, does not use logical thinking, cannot reason by implication — Directed by simple goals, activity includes crude trial and error corrections — Cannot coordinate variables, has difficulty in recognizing multiple properties of objects, often satisfied with multiple, sometimes contradictory explanations — Lacks operational reversibility in thought and action
Concrete Operations	7-8 years to 11-12 years	— Thinking becomes concrete but not abstract, however, elementary logical operations can be performed, and elementary groupings of classes and relations can be accomplished — Concepts of conservation develop in order of number, substance, length, area, weight, and volume — Concept of reversibility develops — Cannot isolate variables, proceeds from step to step in thinking without realizing relationship between them
Propositional or Formal Operational	11-12 years to 14-15 years	— Formal abstract thought ability begins to develop, marked by appearance of hypothetical—deductive reasoning based upon logic of all possible combinations, development of combinatorial system and unification of operations into a structured whole
Arlin's Fifth Piagetian Stage	14-15 years and up	— Ability to perform controlled experimentation develops, keeping all but one factor constant — Ability to hypothesize variables before experimentation, to reverse direction between reality and possibility, develops — Can use interpropositional operations, combining propositions by conjunction, disjunction, negation, and implication

Ref.: Engleson, D. C. et al. (1985) A Guide to Curriculum Planning in Environmental Education. Wisconsin Dept. of Public Instruction, Madison, WI :7.

Figure 2.

Correlation between Piagetian Stages and Brain Growth Periods



Ref.: Engleson, D. C. et al. (1985) A Guide to Curriculum Planning in Environmental Education. Wisconsin Dept. of Public Instruction, Madison, WI :8.

This curriculum plan assumes that most students in grade 3 are 8-9 years old, in grade 4 are 9-10, in grade 5 are 10-11, and in grade 6 are 11-12. Most students in grade 3 are in the developmental stage of concrete operations and beginning a brain growth plateau period. Most students in grade 4 are developing concrete operations, approaching formal operations, and nearing the end of a brain growth plateau period. Grade 5 marks the beginning of formal operations and a spurt in brain growth for many youth. Youth in grade 6 are generally developing formal operations and ending a brain growth period.

Overall, children 9-12 years old may be regarded as pre-adolescents. They tend to be concerned with things rather than ideas and often express their curiosity. They are involved in learning group cooperation and to enjoy the company of others. The need to adopt adult role models, other than their parents and especially in teachers and group leaders, is frequently expressed by these youth. In this period of life, physical development varies, but most people progress in fine muscle coordination and show a propensity for specific skills. (adapted from Wilson 1949)

A concern for all aforementioned growth and development characteristics and their implications is evident in the *Course of Study* (White, et al. 1985) which shows not only a steady progress in education, but also a change in education at about the fifth grade. For instance, in the science area, grade 4 "reviews the three states of matter" and grade 5 "explains the composition of matter." In the social studies area, grade 4 "identifies the branches and levels of government," while grade 5 "explains the development, structure and function of government." An art student "begins to make simple judgments about own art and that of peers" in grade 4. The same student progresses and "makes judgement about art based upon the elements of design and interpretation" in grade 5. This is not to say that grade 5 students are expected to perform a variety of new tasks or that they have dramatically developed. Still, it does indicate an awareness on the part of Columbus Schools that youth do grow in stages and education should facilitate growth.

This curriculum plan is designed with audience growth and development needs taken into account. The previously described characteristics point out some of these needs. Thousands of books about human growth and development have been written, e.g. 2,603 on child development and child and adolescent psychology are contained at The Ohio State University. To suggest that all of the audience growth needs have been identified here would be inaccurate.

Other specific audience needs which are recognized by programs within this curriculum plan are taken from the *Course of Study* (Ibid). These needs are discussed as a preface to individual program implementation

strategies. Programs at CZA are based in environmental education which is interdisciplinary and multidisciplinary. Therefore, an attempt is made to infuse the topics of programs with a variety of subjects which the audience needs to be familiar with.

Program Implementation Strategies

Programs at the Columbus Zoo Aquarium (CZA) for students in grades 3 through 6 should emphasize environmental knowledge and attitudes with reference to Table 1. (p. 13). Table 2. (p. 14) indicates a number of specific goals for these programs to address. After reviewing audience needs, specific instructional objectives may be developed which support the goals outlined in Table 2. In all of this, the basic aim is to help students understand environmental concerns and to foster a set of values and feelings which will motivate them to participate in the resolution of environmental issues.

CZA's educational goals and objectives for students in grades 3 through 6 are broad and diverse. Strategies to meet these objectives will cover many topics and expose students to a variety of experiences. A single field trip to CZA in the absence of other classroom preparation cannot adequately suffice to cover this wide range of goals. This curriculum plan is developed on the precept that CZA views its role as that of a resource to facilitate the educational needs of students through support of teachers by providing curricula and programs.

As such a resource, CZA can effectively influence the knowledge and attitudes of students who attend its programs if a variety of factors are taken into consideration before, during, and after the field trip. A considerable amount of research by Falk and his associates clarify some of these factors (Falk, Martin, and Balling 1978, Falk and Balling 1980, Martin, Falk, and Balling 1981, Falk and Balling 1982, Falk 1983). The essence of this research deals with the psychological novelty effects a student experiences on a field-trip. Some of the questions inherent in their studies include, (Falk 1983):

"Do children learn on field trips? If so, what do they learn? What are the factors that influence what and how much they learn? How can schools use field trips more effectively? How can museums, zoos, and outdoor centres provide better educational services?"

Falk, et al. (1978) discuss the effects a field trip to a novel environment have on student learning based on students familiarity with the novel setting. They found student performance and positive behavior increased in student groups more familiar with the novel setting. Student groups which were unfamiliar with the novel setting exhibited a need for exploration of the strange environment before structured learning could be effectively initiated. They state:

"The practical import of these findings is obviously that educators must deal with environmental novelty in designing standard enrichment experiences. The authors suspect that many experienced educators do this already, either by intuition or conscious intent. This study clearly suggests, however, that a single educational strategy for all drop-in, one-shot field-trip classes can be problematic. Not only will some classes, depending upon past experience, be more capable of dealing with structured learning activities than others, but also certain class members more so than others."

"Novelty, and the very powerful needs for exploration it generates, is an extremely important educational variable. The challenge for educators is to harness this variable to enhance rather than hinder our educational objectives. It is important to understand what is producing uncertainty and exploratory drives on the part of the child so that we can both stimulate it when useful and assuage it when necessary. The novel field-trip phenomenon should not be considered as a negative behavior to be overcome before "real" learning can occur, but rather as a dialogue between the child and his environment - something to understand and capitalize upon."

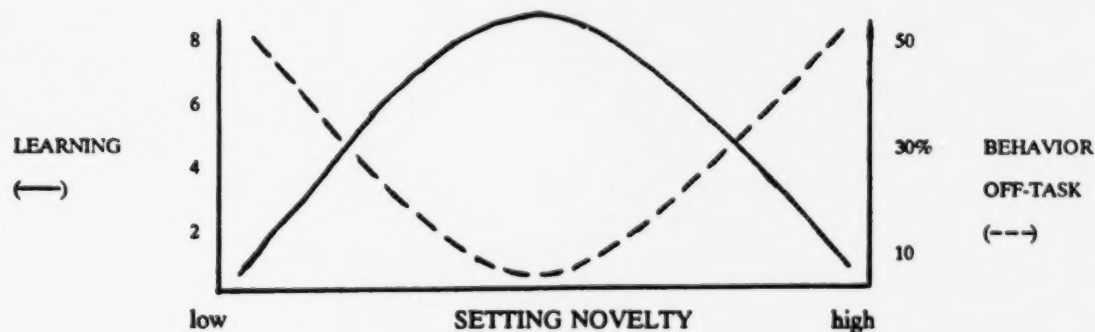
Falk and Balling (1980) continue studies from these findings and suggest field trips should allow students an opportunity for structured exploration of a novel environment. They believe novelty may be viewed on a continuum:

"...extreme novelty causes fear, excitement, and nervousness. At the other end, settings that are too familiar cause boredom, diversionary activities, and fatigue."

This continuum has two aspects, learning and behavior. Optimally, high task learning is associated with low non-task behavior. The following model visually shows a qualitative relationship which the researchers found between setting novelty and these aspects:

Figure 3.

A Model Depicting Task Learning and Non Task Behavior
As a Function of Setting Novelty



Ref.: Falk, J. H. and J. D. Balling (1982) The Field Trip Milieu: Learning and Behavior as a Function of Contextual Events, Journal of Educational Research 76 (1):22-28.

Falk and his associates have tested this model many times in many different situations involving students on field trips to novel, stimulus rich environments like CZA. Falk explains how it should be interpreted, (1983):

"Task learning, shown on the left-hand side, represents the information and concepts educators hope children will gain from a visit to a zoo... The non-task behavior is shown on the right-hand side of the figure. In the model, we have two overlapping mirror-image curves. Task learning tends to be maximal when non-task behavior is minimal. Note that this occurs somewhere in the middle of the setting novelty continuum. At the novelty extremes, non-task behavior is great, learning is little. Too little novelty, or too much, are thus counter-productive to task learning."

This model represents a challenge for designing educational programs at CZA. The concept of "one program for all audiences" is destined to failure. Different audiences have different perceptions of the setting's novelty and will react in varying ways with respect to the continuum. Students in grade 5 may consider the setting novelty "low" and become bored and disruptive. The same setting may have "high" novelty for third graders. As a result they may be too excited and nervous to effectively participate in "the program." An educator may try to adjust "the program" to accommodate these reactions by varying the presentation or modifying expectations, but this is in disregard of the setting and counter-productive to the overall educational effort.

In actuality, what these studies call for is a program uniquely designed for an audience to take advantage of their perception of the novel environment. The idea is to develop a field-trip which exposes the student to a "moderate" amount of novelty by manipulating the location where learning occurs. This presents another challenge for education at CZA because the physical location is given. There are several options to deal with this however, including pre-visit orientations, repeat visits, and limiting student exposure to the setting.

As part of this research, Falk (1983) has compared the effectiveness of several different approaches to preparing students for a single-visit field trip to a zoo. Thirty one classes of grade four students were involved. Some of the classes received cognitive information about conceptual and factual material they would be taught as part of a guided tour. Other classes were provided with strategies to help them observe animals on the tour. And, some classes were given an orientation describing the zoo and the field trip. At the zoo, all classes participated in a guided tour called "Mammals that Swim" which highlighted polar bears, sea lions, seals, and river otters. From the results of a pre-test, a post-test four days following the trip, and a 90 day post-test, all groups "demonstrated highly significant learning." An interesting twist to this is discussed by Falk, (1983):

"Overall, the orientation pre-trip programme produced the strongest positive impact on learning relative to the Controls."

"The results bear emphasizing; children who were informed of such seemingly irrelevant items as what food was sold at the snack bar and what toys at the gift shop, showed greater learning about sea lions and polar bears than did

children who were provided, prior to the trip, with relevant information on sea lions and polar bears. The results can be interpreted as the primacy of children's need to acquire information about the novel settings in which they find themselves."

Another option CZA educators have to reduce the novelty effects experienced especially by younger students is the encouragement of multiple visits. Certainly, school groups may have some logistical problems to overcome to accomplish this, but there is justification to do so in that greater learning can be accomplished. Falk explains, (1983):

"Generalizing from our work, most children in the age range of 10-12 are ready for day-long field trips to novel settings such as... zoos and should even thrive on them. By contrast, younger children may not be as receptive unless more than one trip can be planned. Our research suggests that repeated visits to a site often produce the best learning results at all ages, but particularly for very young children. A first visit can emphasize activities that will familiarize students with the setting, while later visits can focus on more conceptual material."

Because CZA is located within the Columbus Zoo complex, students on a field trip to CZA will be exposed to a multitude of novelties which may not be part of CZA programs. Young students might be especially affected by these stimuli. One way to manipulate this aspect would be to inform students prior to the field trip that their visit would only include the actual Aquarium. Upon arrival, the students should be immediately directed to the Aquarium for a structured exploration of just that building. By channeling their attention toward the Aquarium and its inhabitants, an attempt is made to help them disregard the rest of the Zoo's novel environment.

The contributions of Falk and his allies are significant. They have clearly demonstrated a setting's novelty can have a dramatic effect on learning and behavior. Developing programs which take the novel phenomenon into account will necessitate work for CZA educators. The reward should be a better educational experience for all concerned and may help to eliminate some of the educator's role as disciplinarian. In summary, Falk states, (1983):

"Our research also supports the notion that significant cognitive learning can, and frequently does, occur on field trips. The information acquired on a field trip may be remembered for a long time. Our positive results on cognitive learning can be coupled with years of anecdotal evidence asserting that field trips are thoroughly enjoyed by students and teachers and that these trips produce long-lasting, positive memories of such informal learning institutions as... zoos... In fact, per unit time, children may spend more time involved in learning activities on a field trip and get more out of an informal learning experience than they do in a conventional school classroom. The key to ensuring that students will benefit from field trips is to realize that settings do have an effect on learning."

The research of Falk, Balling, and Martin has been reviewed at length as it is deemed to be particularly important to the development of this curriculum plan. Other researchers have also studied field trips mostly to determine the effects of pre-instruction, instruction during, and post instruction on the cognitive and affective domains. Some of these studies are referenced in the preparation of this curriculum.

Gennaro (1981), Wright (1980), and Pizzini and Gross (1978) examined the value of pre-instructional materials and generally found the use of these items to significantly contribute to cognitive gains. Finson and Enochs (1987), Flexer and Borun (1984), and Pizzini and Gross (1978) studied the results of field trips which utilized varying amounts of instruction during and after the visit to conclude these trips can have an effect on attitudes. Stronck's (1983) research shows different degrees of instruction during the field trip may result in a relation of varying degrees of cognitive and affective outcomes.

The importance of these studies is they indicate it is possible to affect environmental knowledge and attitudes through field trips to informal learning centers such as CZA, if sound pedagogy is implemented. An accepted purpose of this curriculum plan is to design such pedagogy. The rationale for developing individual programs for specific audiences has been discussed. The rest of this section will speak to actual programs which could be employed at CZA. The writer intends this as a conceptual framework of educational themes and activities. Further development of these ideas is left to CZA educators.

Table 2. (p.15) specifies CZA's educational goals which deal with environmental knowledge and attitudes. Basically, all of the Level I, II, and III goals have a knowledge component. Attitude shifts may be realized through programs aimed at Level II subcomponent goals E, F, and G, and Level III subcomponent goals E, F, G, and H. Further selection of these goals for actual programs is based on specific audience needs.

A systematic review of the *Course of Study* (White, et al. 1985) is initiated to determine student needs. It is also useful to consult with the classroom teachers of these students to clarify needs. Education at CZA is multidisciplinary so an effort is made to incorporate all of the subjects studied by the students. These subjects include; Language Arts, Mathematics, Reading, Science, Social Studies, Health, Physical education, Art, and Vocal Music.

With regard to this process, the following programs are tentatively proposed as examples of the kinds of learning activities that could significantly enhance education at CZA.

Proposed Programs for Implementation

Sea Shells, Sea Shores, Sally, and Sam

To become environmentally knowledgeable the assimilation of ecological foundations is critical. This program unit introduces students to some ecological concepts through an investigation of marine and aquatic life found in coastal regions and explores some associated environmental influences on these organisms. Values dictate our perceptions of the quality of life and of the environment. This program unit provides students with an opportunity to recognize how values are part of a few environmental issues affecting coastal areas and how people are part of these environments. Students are encouraged to gain competence in skills associated with all subject areas.

- Audience:** Students in grade 3 from Columbus Public Schools
- Scheduling:** Depending on the depth a teacher wishes to explore these concepts, this program unit will require about 15 class periods and includes at least one field trip to CZA.
- Goals:** Level I: A. B. C. D.
Level II: A. B. E.
Level III: E.
- Instructional Objectives:** After completion of the program unit students will be able to:
- I. Define in their own words the concepts of individuals and populations. Demonstrate the ability to group individuals into populations. Identify population characteristics of selected individual aquatic organisms.
 - II. Discuss the needs of aquatic life and aquatic food chains. Cite examples of competition between aquatic organisms and the adaptations which help selected organisms compete. Explain how people can effect and are affected by aquatic life. Draw an illustration of an aquatic food chain.
 - III. Discuss radiant energy and its importance to aquatic life. Cite examples of physical and chemical changes in an aquatic environment. Explain the water cycle and draw an illustration of it.
 - IV. Recognize how people's cultural activities influence the use of natural resources. Recognize how an individual person's activities influence the use of natural resources. Discuss how changes in an individual's values can affect culture and the environment. Read a selected book about resource use and write a report paper describing their opinion of the book's subject.
 - V. State reasons factual information is relevant to making sound decisions. Gather information about aquatic environmental issues and predict outcomes of decisions based on this information. Bring an article about an aquatic environment to class and share the article in a group discussion.
 - VI. Begin to recognize that their own values are learned and influenced by cultural and environmental factors. Participate in a group values clarification activity concerning a selected aquatic environmental issue. State their opinion in writing, about this issue and their perception of its possible solution.
- Program Unit Outline:** Following is a synopsis of sources for classroom activities selected to support the instructional objectives. A teacher should review these activities and modify, supplement, and include others to create a unit specifically designed for their students in light of the instructional objectives. In developing this curriculum plan it is assumed that the teacher already employs some methods to instruct students about many of the objectives as they are concurrent with the *Course of Study* (Ibid.).

I. Individuals and Populations.

Activities should be selected to support this objective which introduce students to marine and aquatic organisms from coastal regions. Special emphasis is given to invertebrate forms which the students will touch on the field trip.

- A. An introductory fingerprinting activity helps students view themselves as an individual of the human population, (Allen 1981).
- B. "Scallops, Whelks, and Process Skills" (Cleare 1985) continues exploration of the concepts using shells of marine and aquatic organisms.
- C. Etzod's "Classification Shell Game" (1983) ends with an exercise in constructing a key to some shells.
- D. A conceptual approach is provided by Demchik and Demchik (1987).

II. Needs of Aquatic Life, Aquatic Food Chains, Competition, Adaption, and People.

Activities should be selected which relate these objectives to aquatic life found in coastal environments.

- A. *Living in Water* (National Aquarium in Baltimore 1987) contains many activities on these concepts which can be easily adapted to suit an individual classes needs.
- B. *Marine Science Activities, Grade Two* and *Marine Science Activities, Grade Six* (Kolb 1979) have numerous activities concerning these topics, readily modified to suit.
- C. *Aquatic Project Wild* (Western Regional E.E. Council 1987) contains many activities, also.
- D. *Aquatic Habitats, Level 4 - 9* (Weigel 1980) is another source to use.
- E. *Water World Creatures* (Kelly and Phelan 1982) could be helpful.
- F. *A Sea Creature Treasury* (Gray and Forrest 1982) is full of ideas.
- G. *The Ocean: Consider the Connections...Educational Activities for Children* (Bierce ed. 1985) has many activities used by many public aquariums.
- H. *Life on Rocky Shores* (New England Aquarium 1985) details activities related to tidepool ecology.
- I. *Come with Me* (Perea 1978) includes activities and a tape recording to accompany them.
- J. *Ocean Related Curriculum Activities, "ORCA"* (Marret, et al. 1980) has pertinent information and activities.
- K. "The High Cost of Eating" (Slesnick 1983) references a board game pertinent to the topics.
- L. "Life on the Fringe: A Salt Marsh Game" (1988) is a simple game which reinforces the concepts.
- M. Several activities available from the Ohio Sea Grant Program apply to these objectives. A publications list is appended. See OEAGLS 9 and 11, and all OEAGLets.
- N. There are many examples of support materials and other sources of information about this group of concepts appended to this curriculum plan.

III. Radiant Energy, Physical and Chemical Changes, and The Water Cycle

The teacher should discuss beach processes as part of the instruction under this objective. These processes will be further investigated on the field trip.

Most of the sources in section II. above contain information and activities on these objectives as well. Additionally, the following references are suggested:

- A. *Water-Related Teaching Activities* (Coon and Price 1977) has many activities on these topics.
- B. *Maryland: Mountains to the Sea* (National Aquarium in Baltimore 1983) incorporates several activities about the water cycle as a preface to viewing an aquarium exhibit.
- C. Ohio Sea Grant "OEAGLS" 6 and 7, see appendix.
- D. More information and ideas for activities are appended.

IV. Cultural and Individual Influences on Natural Resources.

Accomplishment of this objective group depends largely on teacher initiative. *The Course of Study* (Ibid.) suggests students will gain exposure to these concepts. The idea here is to add an aquatic aspect to the experience.

- A. "A Selected Bibliography of Children's Literature of the Sea" by Norma Bagnall is published in *Marine Science Activities, Grade Two* and also in *Marine Science Activities, Grade Six* (Kolb 1979). This is one of the most complete listings which could be useful in finding books for students to read.
- B. *Water World Creatures* (Kelly and Phelan 1982) includes four books written specifically for lower elementary lessons about marine life. This is a conceptually similar approach to the instructional objective.
- C. *The Ocean: Consider the Connections...Educational Activities for Children* (Bierce ed. 1985) contains a more current booklist.
- D. *Life on Rocky Shores* (1985) also has a bibliography for children.
- E. *Supplemental Curriculum Activities to Accompany Holling's Paddle-to-the-Sea* (Seager, et al. 1988) is a complete set of activities for use with a classic children's book. Available from Ohio Sea Grant, see appendix.
- F. "Fiction and Environmental Education" (Schmidt 1979) is a bibliography with short descriptions of the works cited. This list is not specific to aquatic topics.

V. Decision Making Relative to Aquatic Environmental Issues.

Again, this depends on teacher initiative but it is consistent with current studies. Just add an aquatic twist.

- A. "Bibliography of Juvenile Information Books of the Sea" by Norma Bagnall is published in *Marine Science Activities, Grade Two* and also in *Marine Science Activities, Grade Six* (Kolb 1979). Books on this list are a good place for students to find information.
- B. *North Carolina Marine Education Manual* (North Carolina State University 1982) references many periodicals and other sources of information.
- C. "You Have To Have An Ocean To Teach about the Ocean" (Fortner 1980) details some agencies to contact for information and activities.
- D. "Marine Education Materials System" (Gammisch and Gray 1980) discusses a clearinghouse for marine education information and activities.
- E. Local newspapers like the *Columbus Dispatch* frequently contain related articles.
- F. Certainly, there are many other sources. Given the opportunity, students will find them.

VI. Values and Aquatic Environmental Issues.

Values clarification exercises can be serious fun. If the teacher is not familiar with these activities it might be useful to read Engleson, et al. (1985) for some helpful suggestions.

- A. *Fairy Tales of the Sea* (Cowan and Davis 1981) uses fairy tales to illustrate values.
- B. *Aquatic Activities for Youth* (Green, et al. 1980) has a costal planning simulation game.
- C. *Wanchese Harbor Community Development* (Gray and Martin 1982) contains a series of activities which explore the instructional objective.
- D. *Early Maritime Cultures of North Carolina* (Platania and Haught 1983) provides a historical perspective through related activities.
- E. *Coastal Problems and Resource Management* (1979) is a simulation game for Ostrich Bay in Hawaii that could be modified for use.
- F. *Aquatic Project Wild* (1987) is another source of pertinent activities.
- G. *Simulation Games and Learning Activities Kit for the Elementary School* (Reese 1977) is an excellent book for activity ideas which could be adapted.

Field Trip Outline:

Following is a synopsis of ideas and sources for activities to be conducted at CZA. These activities should be selected with reference to the instructional objectives and further the concepts students are studying in school.

1. Structured Exploration of CZA.

- A. After students have arrived a brief orientation tour of the Aquarium should be conducted. This is not intended to be extensive. Just point out the rest rooms, drinking fountain, and the area students are permitted to explore.
- B. Provide students with a "Seek and Find" type of activity which encourages them to locate a variety of things in the Aquarium. Allow the students to complete the activity on their own or in pairs.
- C. After the above activity, assign each student to an individual aquarium exhibit and provide them with an activity sheet which directs their attention to discover aspects of the tanks contents.
- D. Follow this with a tour of the Aquarium in which individual students discuss their tanks contents relative to their observations. This might require splitting the class into small groups to make it easier for students to communicate with each other. It is not imperative every student hears about every exhibit. The aim is to allow each student an opportunity for self expression.

These references might be useful in constructing the above activity handouts:

- a. *Teachers' Manual for the Aquarium of Niagara Falls* (Aquarium of Niagara Falls) contains some activities on pages 9, 10, and 80 which could be adapted to CZA.
- b. *Educator's Guide to the National Aquarium in Baltimore* (Chase, et al. 1984) includes several activities which illustrate different formats CZA might consider.
- c. *Coral Reefs: A Gallery Program, Grades 7-12* (National Aquarium in Baltimore 1983) has a handout on page 10 that could be modified for CZA.
- d. "A Treasure Hunt At the Zoo" (Christopherson 1981) suggests ideas for "Seek and Find" activities.
- e. "First Look at the Zoo" (Wurzelbacher 1979) has some ideas and activities.

- f. "Study of Animal Behavior in a Zoo" (Settel 1985) sparks thoughts for developing a tank study handout.
- g. "Variation, Adaption and Evolution at the Zoo" (McComas 1988) is an in depth approach to the concept which might be scaled to a third grade level.

2. Sand Box Science.

- A. Split a large class in half. One half participates in sand box science while the other goes to the Touch Tank. At a prearranged time, the groups will switch activities. Activities at several large sand boxes focus on sea shells and beach processes. Different sand boxes contain different sized sand to represent the sorting found on a beach.

The references contained under program unit I. and these articles should help CZA to develop activities for Sand Box Science:

- a. "Year of the Coast" (Jacobix and Lux 1980) contains information about impacts on coastal areas.
- b. "Discovery Through Sand Play" (McIntyre ed. 1982) introduces different sized sands.
- c. "Sand" (Van Deman 1980) points out magnetic qualities.
- d. "Wind and Waves" (Van Deman 1979) discusses beach processes and an activity adaptable to sand boxes.
- e. "Getting Acquainted with Beaches and Coasts" (DeWall 1980) has more on beach processes.
- f. "An Affair with Sand" (Stroud 1980) suggests sources for getting sand and a photograph activity.
- g. "Shoreline Activities" (Stout 1980) pertains to a project CZA could use to illustrate beach processes.

3. Touch Tank Time.

- A. Several activities at a touch tank could provide students with an opportunity to feel animals they have studied. A touch tank is an interactive exhibit which necessitates some personal interpretation and monitoring. The point of the exhibit is to encourage students to discover these animals via their senses and not to provoke them to learn the names of every organism in the tank or to inform them of a multitude of facts.

Many major aquariums have touch tanks. Perhaps the most efficient way to develop activities at CZA for its touch tank would be to contact other aquariums. Ken Sherwood, with Mystic Marine Life Aquarium, has studied touch tanks from an ethical perspective. It could be useful to contact him for a copy of his work. As the writer understands it, he has shown dried specimens to have educational value. The following articles contain ideas for activities:

- a. "Intertidal Organisms" (Korporaal 1980) discusses the tidepool environment and its inhabitants.
- b. "Sea Anemone: Investigations" (Hunt 1982) involves some close up looks at sea anemones.
- c. "Marine Snail Investigations" (Hunt 1985) focuses on marine mollusks.

4. Take Home Project.

- A. In keeping with the Zoos educational philosophy to provide participants with a souvenir of their experience at the Zoo, an art project serves this function.
- B. While working on the art project, it would be fun to teach the students some "water" songs to take home, also.

Two possible art projects which relate to the topics students have been studying are sand paintings and invertebrate mobiles. Various songs are appended and some records which could be played are listed below:

- a. Directions for sand paintings are found in *Marine Science Activities, Grade Two* (Kolb 1979). It has songs also.
- b. Cut-outs for making an invertebrate mobile are contained in *Teachers' Manual for the Aquarium of Niagara Falls*. These shapes could also be drawn by the students and stuffed as detailed in "Ecology and Art" (Wheatley 1979).
- c. Songs and Sounds of the Sea (1973) National Geographic Society, Washington, D.C.
- d. World of Water (1987) Pacific Science Center, Seattle, WA
- e. Heart of Oak (1976) Folkways Records, New York, NY.

Some additional ideas to support the program: When teaching students about aquatic food chains, zooplankton could be kept in the classroom for observation. Other projects which can be used to illustrate a variety of ecological concepts include keeping a classroom terrarium, aquarium, or touch tank. Some articles to read for information about these projects are:

- 1) "Zooplankton in the Classroom" (Chase 1987) has information on collecting, preserving, and some activities.
- 2) "Daphnia" (Kramer 1987) tells how to raise and breed daphnia.
- 3) "Daphnia—A Handy Guide for the Classroom Teacher" (Collins and Collins 1985) lists features and an activity sheet.
- 4) "Outdoors On a Window Sill" (Rice 1982) describes terrarium keeping.
- 5) *North Carolina Marine Education Manual* (1982) contains directions for maintaining aquariums and touch tanks.
- 6) "What's Inside the Shell?" (Hunt 1983) provides ideas for investigating and the care of marine hermit crabs.

There are many other articles on keeping aquariums in the classroom, some of which are appended. If a teacher is interested in this, it would be a good idea to contact CZA for the latest information on this topic and for advice.

Aquatic Life and the Edge of Existence

Today's actions determine tomorrow's consequences. In the development of a global environmental ethic it is imperative that students understand this. This program unit encourages students to examine various species of aquatic life, the needs these organisms have, and the factors which endanger survival for some. An opportunity is provided for students to explore human impact on aquatic environments and how the values different people hold affect their decisions toward aquatic environmental issues. Students are encouraged to gain competence in skills associated with all subject areas.

Audience: Students in grade 4 from Columbus Public Schools

Scheduling: Depending on the depth a teacher wishes to explore these concepts, this program unit will require about 15 class periods and includes at least one field trip to CZA.

Goals: Level I: E. H. I.
 Level II: C. F.
 Level III: A. C. F.

Instructional After completion of the program unit students will be able to:
Objectives:

- I. Define in their own words the concept of an aquatic community. Discuss the needs of selected species of aquatic life. Cite examples of competition and adaption in an aquatic ecosystem. Draw an illustration of an aquatic food web.
- II. Recognize people are part of an aquatic ecosystem. Discuss affects of people's activities on an aquatic environment. Compare and contrast aquatic environments with other environments including human created, and discuss how these environments are related to aquatic life. Read a book about an endangered aquatic animal and write a report paper which describes environmental factors impacting the animal.
- III. Gather information about specific aquatic environmental issues. Discuss these issues in terms of their view of conservation and their perception of the value of natural resources. Recognize that people have different values and that values provide basis for making decisions about issues. Bring an article about a specific aquatic environmental issue to class and share the article in a group discussion.
- IV. Use a library and other sources to locate information about a specific aquatic environmental issue. Use this information to support at least two different views of the issue in a preliminary draft report or outline. Participate in a group values clarification exercise concerning the issue. Write a report paper expressing different opinions of the issue and their own opinion regarding the issues solution.

Program Unit Following is a synopsis of sources for classroom activities selected to support the instructional
Outline: objectives. A teacher should review these activities and modify, supplement, and include others
 to create a unit specifically designed for their students in light of the instructional objectives.
 In developing this curriculum plan it is assumed that the teacher already employs some methods
 to instruct students about many of the objectives as they are concurrent with the *Course of
Study* (White, et al. 1985).

I. Aquatic Communities, Needs of Aquatic Life, Competition, Adaption, and Aquatic Food Webs.

Activities should be selected which relate these objectives especially to aquatic life directly influenced by current issues which the students will study in this program unit.

Sources in section II. of "Sea Shores, Sea Life, Sally, and Sam" contain information and activities on these objectives. See these sources too:

- A. *Marine Biology and Oceanography, Grades Seven and Eight* (Kolb 1981) has many activities which could be adapted.
- B. *Investigating the Marine Environment: A Sourcebook* (Weiss and Dorsey eds. 1979) includes activities and information appropriate for the objectives.
- C. *Marine Organisms in the Classroom* (Hampton and Weston 1982) contains some activities on invertebrates.
- D. *Sea Turtles: An Auditorium Program* (National Aquarium in Baltimore 1985) includes a variety of activities on endangered sea turtles.
- E. *Seals* (New England Aquarium 1985) discusses a marine mammal rescue program and a few activities.
- F. "Up From the Triassic" (Weber and Maraniss 1985) is an article about sea turtles with activities on them.

G. "Meet Mona, the Manatee" (Frank 1988) details an extensive activity for fourth graders to discover endangered manatees and some interesting information on them.

II. People, Environments, and Aquatic Life.

The teacher will want to give balance to this investigation by helping students to see both positive and negative affects and relationships. The Frank (1988) article (G. above) demonstrates this in a few paragraphs.

Use the sources listed above and in sections II. and IV. of "Sea Shells, Sea Shores, Sally, and Sam" to find activities and references on these objectives.

III. Conservation, Values, and Issues.

Accomplishment of these objectives relies mainly on teacher initiative. The *Course of Study* (Ibid.) outlines these concepts. A teacher could add an aquatic aspect to the presently used unit.

Section V. of "Sea Shells..." lists appropriate sources.

IV. Expressing an Opinion Relative to an Issue.

Students often enjoy the opportunity to express their opinions. A values clarification exercise can help them to examine these opinions. Engleson, et al. (1985) provides some useful tips.

Some of the sources in "Sea Shells..." section VI. could be used and the following:

A. "An Endangered Species Simulation Game" (Lustig 1983) could be adapted to an aquatic community.

B. There are several Ohio Sea Grant "OEAGLS" which could be used, see appendix.

Field Trip Outline: Following is a synopsis of ideas and sources for activities to be conducted at CZA. These activities are selected with reference to the instructional objectives and support the concepts students have studied in school.

1. Structured Exploration of CZA.

A. Present a brief Aquarium orientation to students upon arrival. This is to define areas students may explore, and where the restrooms and drinking fountain are.

B. Provide students with a "Seek and Find" type of activity. This is more specific than the third grade activity. Students may be asked to locate specific organisms and to find examples of ecological concepts. Allow students to work on their own or in pairs.

C. For the next activity, assign students to individual tank exhibits and give them an activity sheet. This handout includes information about an issue which relates to the exhibit. In addition to making observations of various aspects of the exhibit, students will also record their opinions of the issue based on the information provided and previous knowledge.

D. Follow this with a tour of the Aquarium in which students discuss the multitude of issues affecting aquatic habitats around the world. Logistically, this may require dividing the class into smaller groups for more interaction among the students. The focus of this activity is to allow each student to express their views. It is not necessary for each student to hear about each exhibit.

The development of these activity handouts will depend greatly on the initiative of CZA educators to locate and synthesize information a multitude of pertinent issues. CHECK THIS Ideas for format and style might be derived from the corresponding section 1. of "Sea Shells..." An article which relates to this is:

- a. "Endangered Species: A Last Look" (Wurzelbacher 1979) suggests use of a symbol on exhibits will notify visitors of the endangered status of a displayed animal and has some relevant information.

2. Opinions of Professionals.

- A. Students have been discussing and becoming familiar with a variety of aquatic environmental issues. In class and at CZA they have had a chance to express their opinions about some of these issues. This aspect of their field trip will expose them to the opinions of three Zoo employees. These professionals will present their own personal values relative to a selected aquatic issue in the form of a short talk of at least 5 minutes but not exceeding 10 minutes. The content of this talk should be based on why they believe, what they believe. They might wish to share how their values influence their work or actions taken in their lives.

The speakers will entertain questions about their beliefs immediately after their talk. The teacher should monitor the question period to direct attention to values or issues clarification.

Efforts should be taken to schedule speakers at least a week before the program. The speakers can be any Zoo employee regardless of their position. In the writers experience similiar programs have been enjoyed by both students and speakers. In many cases the speakers found the challenge of expressing their values to be a stimulating and rewarding experience.

3. Aquatic Ecology Investigations.

- A. Several hands-on types of activities will be implemented. These activities should have application to the issues students have been exposed to. Emphasis is placed on allowing students to demonstrate to themselves the natural processes that occur and how human intervention affects these processes in an aquatic environment.

For activities, consult the array of sources cited throughout the program unit outlines.

4. Take Home Project.

- A. The Zoo's educational philosophy recognizes the souvenir value of take home projects. Students will make buttons to serve this function.
- B. During button construction, it would be fun to teach the students some "water" songs to take home, too.

Buttons have been made at the Zoo before. It is an internal task to locate the equipment and supplies. Several songs are appended.

Aquatic Environmental Issues Investigation and Evaluation

A dynamic equilibrium exists between quality of life and quality of the environment. Citizens have rights and responsibilities toward achieving and/or maintaining this equilibrium. Decisions about the balance between these qualities are based on values and knowledge. This program unit encourages students to explore this balance through investigation and evaluation of a few aquatic environmental issues and strives to help them define their personal position relative to the equilibrium between quality of life and quality of the environment. Students are encouraged to gain competence in skills associated with all subject areas.

Audience: Students in grade 5 from Columbus Public Schools

Scheduling: Depending on the depth a teacher wishes to explore these concepts, this program unit will require about 15 class periods and includes at least one field trip to CZA.

Goals: Level I: F. G.
 Level II: D. G.
 Level III: B. G.

Instructional After completion of the program unit students will be able to:
Objectives:

- I. Define in their own words the concepts of succession and homeostasis as applied to an aquatic environment. Draw an illustration of successional stages in an aquatic habitat.
- II. Discuss different solutions to selected aquatic environmental issues. Recognize the rights and responsibilities of citizen involvement to solve aquatic environmental issues. As a class or in smaller groups, compose a draft proposal of a law to address an aquatic environmental issue.
- III. Discuss the value orientations behind different solutions to selected aquatic environmental issues and the ecological and cultural implications of these solutions. State a position in writing about the equity of the proposed law using an assigned value orientation and support this position with information acquired from several sources.
- IV. Participate in an investigation of a selected aquatic environmental issue. Evaluate this issues affect on the quality of life and on the quality of the environment. Write a short position paper expressing personal values toward the issue.

Program Unit Following is a synopsis of sources for classroom activities selected to support the instructional
Outline: objectives. A teacher should review these activities and modify, supplement, and include others
 to create a unit specifically designed for their students in light of the instructional objectives.
 In developing this curriculum plan it is assumed that the teacher already employs some methods
 to instruct students about many of the objectives as they are concurrent with the *Course of*
 Study (White, et al. 1985).

I. Succession and Homeostasis.

Activities should be selected which relate these objectives to aquatic life directly influenced by the issues students will study in this program unit.

A. *Marine Biology and Oceanography, Grades Seven and Eight* (Kolb 1981) and the two volumes of *Marine Biology and Oceanography, Grades Nine to Twelve* (Kolb 1979, 1980) have information and activities which could be adapted.

B. *Aquatic Project Wild* (1987) includes several pertinent activities.

C. *Aquatic Habitats, Level 4 - 9* (Weigel 1980) could be used

D. "Classifying Aquatic Habitats" (Smith and Leskowitz 1987) contains some useful information.

E. "Ecological Awareness in the Biology Classroom" (Reichert 1987) has some information also.

II. Solutions, Rights, and Responsibilities.

The *Course of Study* (Ibid.) suggests students will gain appreciation of these concepts. Use of an aquatic issue could satisfy several objectives of units currently being used.

A. *Environmental Issues* (Water Pollution Control Federation) is an activity guide on "citizen responsibility, and legislation which impacts clean water." The writer has not viewed this material but is familiar with other publications by this group.

III. Value Orientations, Ecological, and Cultural Implications

Again, the *Course of Study* (Ibid.) suggests these are appropriate objectives. Focus on an aquatic issue could facilitate instruction of presently used objectives.

Information on aquatic environmental issues is found in the sources listed in section V. of "Sea Shells..."

IV. Investigation and Evaluation.

Activities should be selected which allow students to participate in collecting data, synthesizing information, and evaluating.

- A. *Stream Quality Monitoring* (Ohio Department of Natural Resources) is a "Citizen Action Program" which involves students in assessing water quality.
- B. *Surface Water* (Water Pollution Control Federation 1988) is an activity guide with video support.
- C. *Wastewater Treatment* (Water Pollution Control Federation 1987) is an activity guide with video support which could be adapted.
- D. *Ground Water* and *Drinking Water* (Water Pollution Control Federation) are two other activity guides by this group. The writer has not viewed these, but assumes they apply.
- E. *Baybook* (Citizens Program for the Chesapeake Bay 1987) contains information and ideas to remediate water issues.
- F. "Assessing Stream Water Quality" (Moody 1985) might be modified.

Field Trip Outline: Following is a synopsis of ideas and sources for activities to be conducted at CZA. These activities are selected with reference to the instructional objectives and support the concepts students have studied in school.

1. Structured Exploration of CZA.

- A. After arrival briefly orient students on the location of restrooms, drinking fountain, and the areas they are permitted to be in.
- B. Two avenues exist which depending on the season, the teacher will decide the course of action that best suits their students needs.

2. Option: Scioto River Investigation (see notes).

If the combined temperature of the Scioto River and ambient air is above 120 F. degrees, the teacher may choose this option.

- A. Attract students attention to any exhibits featuring aquatic life they may be able to collect from the Scioto River. Allow students to view these exhibits and the rest of the Aquarium on their own for an appropriate time period.
- B. During this period, the teacher should select students to carry equipment and gear. These students are made aware they are responsible for returning the gear at the end of the activity.
- C. Safety cannot be stressed enough. The teacher should inform students about what they are going to do and the appropriate behavior expected. The activities and the locations are not necessarily dangerous, but inappropriate behavior is not tolerated and will result in termination of the field trip.
- D. The rest of the field trip will involve an investigation and evaluation of two different aquatic habitats. The Scioto River behind the Aquarium is impounded by O'Shaugnesy Dam. In a shallow cove immediately north of the Aquarium, students could explore, seine, and collect aquatic life. This

habitat is typical of large impounded rivers in Ohio. Below the Dam, there are several excellent riffle habitats which students could investigate and compare with the first area.

- E. The opportunity to analyze two completely different aquatic habitats within walking distance of each other is somewhat unusual. There are many activities which students could conduct to discover these environments. It is said there is no substitute for first hand experience. The activities utilized here will provide this.

There are many books and activity sources available to guide this experience. The writer recommends these:

- a. *Stream Quality Monitoring* (ODNR) is a guide for using macroinvertebrates to assess water quality.
- b. *Environmental Science Activities* (Del Giorno and Tissair 1975) has many related activities.

The Ohio Department of Natural Resources sponsors a program which could be modified for use at CZA. Their program is dedicated to streams designated under the scenic rivers system. Although the Scioto River is not designated as such, they might be able to provide useful information. Contact John Kopec, Division of Natural Areas and Preserves, about this, (265-6458).

The Ohio EPA, Division of Water Quality Monitoring and Assessment, employs scientists who collect similar types of data. If contacted, they will share any data on the Scioto River and might have some useful suggestions. Additionally, the Ohio EPA sponsors a speakers group which encourages their staff to present information to organizations like schools. Marc Smith, Fish Evaluation Group Supervisor, can provide more information, (466-3981).

CZA will need to secure appropriate equipment for these activities. Some equipment will have to be purchased like waders, seine netting, and hand lenses. However, much of the gear can be "home made." Directions for constructing some gear are appended.

NOTE: It is illegal to collect some species of aquatic life or to use some collection methods without a special permit. For information regarding these restrictions and to obtain permits, contact the Ohio Department of Natural Resources.

NOTE: CZA must obtain permission (in writing) from any affected land owners to access and use the River.

NOTE: It is a fact. We live in a litigious society. Before CZA offers this option, lawyers and insurance representatives must be contacted.

3. Option: Lake Erie Investigation.

- A. A "Seek and Find" activity might be implemented if students are unfamiliar with CZA, otherwise allow students to view the exhibits on their own for an appropriate amount of time.
- B. Divide the class into three groups. One group will see a multi-media program on the history of Lake Erie and be involved in some related activities. One group will observe a series of exhibits which illustrate successional stages in a Lake Erie habitat. The third group will participate in water quality analysis activities. At a prearranged time, the groups will rotate activities.
- C. The Lake Erie program will highlight the history of the Lake with emphasis on ecology and human interaction. The multi-media presentation should be less than 20 minutes. Following this, several activities will involve students in an investigation of issues affecting the Lake such as chemical loading, non-point source pollution, and international aspects. Students will discuss the implications of these issues and applicable legislation.
- D. With an activity handout, students will record data about a series of exhibits which contain species representative of different time periods in Lake Erie. Students should be able to see a change in

population dynamics through the exhibits. Exhibit graphics will detail some of the information students will record. Other data to be recorded will result from personal inferences.

- E. Water quality analysis activities will provide students an opportunity to test physical and chemical parameters in various water samples. A laboratory exercise sheet will allow them to fill in their results and guide the experience. Students will discuss the implications of these tests in relation to Lake Erie parameters.

To develop these activities, consult the array of sources cited in this curriculum plan. Ohio Sea Grant offers many programs and activities on Lake Erie. Contact Dr. Rosanne Fortner at the Ohio Sea Grant Education office for information on these programs, (292-1078). Also, see:

- a. *Decisions for the Great Lakes* (Misener, et al. 1982) has many appropriate activities.
- b. *Great Lakes Fishing in Transition* (Nowak, et al. 1983) includes information and activities also.

3. Take Home Project.

- A. The above activities will consume a large amount of time. If time allows, a take home project should be developed to provide students with a souvenir of their experience.
- B. Another option to serve the souvenir function would be to sell (or give) the students something which represents their experience. Sales of some item could provide revenue for purchasing needed equipment and supplies.

Aquatic Environmental Issues A Preface to Action

What should a citizen know to be able to make value consistant decisions about aquatic environmental issues? A participant in the preceeding programs should have some concept of the questions to ask in making decisions about such issues and an ability to locate answers. They should also have some concept of how their personal values affect the decisions they make. This program unit is intended as a capstone to the previous programs. To espouse a global environmental ethic requires a dedication to work toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment. This program unit encourages students to evaluate the extent to which their values are consistant with a global environmental ethic.

Audience: Students in grade 6 from Columbus Public Schools.

Scheduling: Depending on the depth a teacher wishes to explore these concepts, this program unit will require about 15 class periods and includes at least one field trip to CZA.

Goals: Level I: Review Ecological Foundations.
Level II: Review Conceptual Awareness, Issues and Values.
Level III: D. H.

Instructional Objectives: After completion of the program unit students will be able to:

- I. Define discrete aquatic environmental issues. As a class compose a list of current aquatic environmental issues. In groups of 3 or 4 students, select one of these issues not selected by any other group. As a group, collect information and define the issue. State this issue in the first part of a group written report.

(The teacher guides students to compose a list which represents issues affecting different aquatic habitats and should encourage a selection process which will result in class presentations on at least one issue affecting marine, river, lake, and marsh habitats.)

- II. Identify viable alternative solutions to an aquatic environmental issue. Discuss the cultural and ecological implications of these solutions. As a group determine several solutions to their issue and compare and contrast these solutions. State these alternative solutions and implications in the second part of a group written report.
- III. Select the solution which is most consistent with their personal values. Select the solution which will improve quality of life the most. Select the solution which will improve quality of the environment the most. Compare and contrast the value orientations associated with these solutions in part three of a group written report.
- IV. Suggest a strategy to solve the issue and ways this strategy can be implemented. Outline the steps to be taken and who should be responsible for implementing this strategy. Cite any roles students may take in this strategy. Record this implementation strategy as part four of the report.
- V. Evaluate predicted outcomes of this strategy in terms of its expected affect on achieving and/or maintaining a dynamic equilibrium between the quality of life and quality of the environment. Conclude the written report with this evaluation.
- VI. Present the information collected in the report and the groups plan to solve the issue to other classmates in an oral report. Cite actions their classmates may take to solve the issue. Entertain questions from classmates following the presentation.

Program Unit Outline: Following is a synopsis of sources for classroom activities selected to support the instructional objectives. A teacher should review these activities and modify, supplement, and include others to create a unit specifically designed for their students in light of the instructional objectives. In developing this curriculum plan it is assumed that the teacher already employs some methods to instruct students about many of these objectives as they are concurrent with the *Course of Study* (White, et al. 1985).

I. Defining Aquatic Environmental Issues.

Activities should encourage students to locate information in the library and from a variety of other sources. Students may wish to contact agencies like the Ohio Department of Natural Resources, Ohio EPA, U.S. Fish and Wildlife Service, The Ohio State University etc.

Information on sources which include addresses of agencies are included in section V. of "Sea Shells..."

II. Alternative Solutions.

Select activities which help students to explore the various options of their issue. Games often contain this element. An article which discusses how to develop a game is:

"Teaching about Local Environmental Issues with an Adapted Board Game" (Fortner 1988) lists steps to take in making a game for students which can be modified.

III. Value Orientations.

Students should recognize that various solutions will have different outcomes. The proponents of these solutions have different values which motivate them to select a particular solution. Some values clarification exercises outline the value orientations behind proposed solutions. Some of these activities might help students to recognize the values behind solutions to the issue they are investigating.

Values clarification exercises are listed in section IV. of "Aquatic Life and the Edge..."

IV. Implementation Strategies.

The teacher should work with individual groups to help them outline a viable plan. For ideas about roles students can take see: A. Baybook (1987) has ideas which could be applied.

V. Evaluation.

Allow the students to formulate this part on their own. The teacher may wish to help them express their ideas in writing but the evaluatory framework should be the students'.

VI. Presentations.

Provide parameters which the students will observe in presenting their work. This should include time, whether all students must talk, types of appropriate questions, etc.

Field Trip Outline: Following is a synopsis of ideas and sources for activities to be conducted at CZA. These activities are selected with reference to the instructional objectives and support the concepts students have studied in school.

1. Structured Exploration of CZA.

- A. Upon arrival orient students to restroom and drinking fountain locations and the areas they are allowed in.
- B. Permit students to explore the Aquarium on their own for an appropriate time period.
- C. Assign pairs of students to individual exhibits which feature different biomes. Students will evaluate these exhibits using a handout containing information about the biome and relevant issues. The handout will ask students whether they think the exhibit accurately represents the habitat found in that biome and what they would do to make the exhibit more accurate. The handout will also ask students to recall information and use exhibit graphics to write about an issue affecting the habitat. And, students will be asked how they would design the exhibit to more accurately communicate the factors involved with the issue.
- D. In small groups, students will tour the exhibits their classmates have evaluated. At each exhibit, the students who evaluated it will lead a group discussion of the issues related to the exhibit. A form will be provided listing questions for the students to pose to their classmates for discussion.

The development of activity handouts will depend on CZA educators' initiative. Information sources and ideas for activity format are listed the preceeding program outlines.

2. Class Discussion.

- A. With all of these issues "fresh in their minds," students will assemble in a room and the teacher will list on a flip chart all of the aquatic environmental issues the class can recall. As each page of the chart is filled it will be posted around the room.
- B. A class discussion will follow. Students will be encouraged to use information to define and suggest alternative solutions to the issues. Opportunities will be available for students to share their opinions of the possible solutions.
- C. If there are any Zoo employees available, they will be welcome to share their insight on these issues.

3. Action Identification.

- A. Having determined a multitude of issues and possible solutions, the class will suggest ideas for actions they can take as individuals or as a group to help resolve the impacts of these issues.
- B. The teacher will list these actions on a flip chart. As each page is filled, it will be posted near the corresponding page identifying the issue around the room.
- C. After the action suggestions have been exhausted, the room should have an impressive quality. Students will have composed a large list of issues and actions they can take to remediate those issues.

In terms of environmental education, the next step would be to motivate students to take these actions and to provide opportunities for them to do so.

Sections 2 and 3 above detail an activity which requires student interaction to be successful. The teacher should work to inspire this interaction but may not be familiar all of the issues involved. A CZA educator will help to clarify these issues and should have some background in leading such an activity. In the writer's experience, similar activities have been well received by students.

4. Take Home Project.

A. The flip chart pages from the activity above should be provided to the teacher to take back to their classroom.

B. For souvenir value the students could make "fish prints." This is a Japanese method to make a record of a fish which has evolved into an art form. Prints the students make are often worth framing.

There are many sources which describe the process with different variations. To get an idea of how it's done see:

a. "Fish Printing" (Grambo 1982) illustrates this activity with students.

Program Implementation Review

It has been convenient to record the program unit outline and then the field trip outline for the programs suggested in this curriculum plan. However, this is not necessarily the order in which a teacher should present these components. The writer views the field trip to be an integral part of the program which should be initiated at an appropriate time during instruction of the concepts as outlined.

The importance of utilizing sound pedagogy is discussed in the Program Implementation Strategies section. Such pedagogy recognizes the value of pre-site, on-site, and post-site instructional materials. Many activities cited in this curriculum plan naturally fall into one of these categories. Others will have to be modified to suit the needs of particular situations. Pre-site instruction and activities introduce the concepts students will be exposed to on their field trip. The field trip includes activities which reinforce and expand the students' perception of these concepts. Back in the classroom, follow-up materials are used to clarify the concepts and evaluate student assimilation of this process. Teachers and Aquarium educators must work together to create a program unit which includes these aspects.

The need for student orientation to the Columbus Zoo Aquarium (CZA) before their field trip has been identified. A slide-tape program could be developed for this purpose. Falk's (1983) research alludes to some factors which such a presentation should include; "...the primacy of children's need to acquire information about the novel settings in which they find themselves," provides a theme for these presentations. These programs should describe the Zoo, the Aquarium, and what students will do on their field trip. In Falk's (1983) work,

"...children who were informed of such seemingly irrelevant items as what food was sold at the snack bar and what toys at the gift shop, showed greater learning..." over children who experienced other types of valid pre-trip orientation programs.

At CZA, students will be involved in observing aquatic life in various exhibits. As an orientation strategy, it might be useful to have an aquarium in the classroom before the field trip to help students develop observation skills. CZA might consider a program to help teachers maintain a classroom aquarium.

Several articles mention the benefits of keeping aquariums in the classroom and how to do it. Some articles a teacher could reference include:

- 1) "Fish Lab" (Alt 1985) describes an elementary school which uses aquariums to teach many related concepts.
- 2) "Science! How Do I Fit It In?" (Howarth 1980) discusses a program which aquariums would compliment.
- 3) "Learning About Sea Life" (Crowe 1981) suggests taped lessons.
- 4) "Aquaria" (Igelsrud 1986) has information on aquarium care.
- 5) "A Saltwater Aquarium" (Hampton and Hampton 1980) includes information on marine aquarium maintenance.
- 6) "A Freshwater Aquarium" (Hampton and Hampton 1979) includes information on aquarium maintenance.
- 7) "A Pond In the Classroom" (Van Deman 1981) details an indoor pond and some advantages of similiar facilities.

Advantages of repeat visits to CZA have been discussed. Young children especially may benefit from this strategy. A first visit exposes students to the novel stimuli of the Zoo and CZA and allows them an opportunity to explore these novel environments. On repeat visits, Falk's (1983) studies show children are capable of learning more conceptual material.

Because CZA is located within the Zoo complex, students on a field trip to CZA will encounter a multitude of novel stimuli which are not necessarily part of their planned experience. A strategy to reduce the influence of these novel stimuli might include informing students prior to the field trip that their visit will only be to the Aquarium. Upon arrival at the Zoo, students should be escorted directly to CZA where they will participate in activities designed to focus their interest toward the objectives of their field trip.

The activities employed by CZA should be developed with respect to the above and designed to meet student needs in light of CZA's educational goals and objectives. These activities are bonded together to create

a specific program for a selected audience. A complete investigation of audience needs is prerequisite to program development. Based on these needs, goals and instructional objectives are established. Programs are developed to achieve these objectives. Evaluation guides program implementation and determines the value of these programs to CZA.

Teacher Workshops

Four program units are identified for use at the Columbus Zoo Aquarium (CZA) in this curriculum plan. These programs are limited to four specific audiences. There are many other audiences at CZA which appropriate programs should be developed for. The method described in this plan could be applied to developing other programs.

The four programs which have been discussed are developed to the instructional objective stage and sources for activities to support these objectives are noted. To develop these programs further, activities need to be selected and formatted to meet the instructional objectives. Conducting a "Teacher Workshop" is an excellent means to accomplish this.

The writer suggests CZA contact Dr. Robert E. Roth, Professor (292-9832) at The Ohio State University, School of Natural Resources, to discuss the possibility of granting graduate credit to teachers who participate in CZA teacher workshops. These workshops could be held at CZA. Leadership for the workshops would be the dual responsibility of CZA educators and University educators. The value of gaining graduate credit may provide incentive for many teachers to participate. University leadership can help to provide theoretical foundation. CZA leadership can insure that program development is correct for the Aquarium and its contents. The possibilities of this dynamic joint venture could have positive rewards for all concerned.

Program Evaluation

Programs in this curriculum plan are developed to meet audience needs in light of the superordinate goal for education at CZA. Programs are presented toward this goal which specifically address knowledge and attitude components. The role of evaluation is to determine the accuracy of perceived audience needs, the ability of a program to meet these needs, and a programs efficiency and effectiveness in satisfying objectives which compliment the goals as stated.

The literature of educational evaluation is filled with specialized vocabulary describing complex concepts. We can avoid most of the technical words, but a few are important. Most educators equate the term "evaluation" with the process of making judgements about student learning. That's an important and complex kind of educational evaluation, but it's only a part of what is

included in program evaluation. Two of the more meaningful evaluation concepts describe two distinct roles of evaluation: SUMMATIVE evaluation and FORMATIVE evaluation," (Lange 1980: 22).

Summative evaluation is concerned with judgements about the relative value of a program. This evaluation describes what a program exists to accomplish and how efficiently it utilizes physical, human, and economic resources. It details program impact in reducing identified needs. Administrators use summative evaluation as a basis for decisions to expand, continue, or terminate resource allocation for programs.

Formative evaluation is concerned with improving and molding a program as it is implemented. Administrators and program developers use this evaluation to identify changes required in a program. Program staff use it to determine the effectiveness of their work and information is collected to that purpose. Such information clarifies how the staff should modify its activities or instructional materials.

Information collected to support these evaluations will be quantitative and qualitative. Quantitative information includes data which can be summarized with numbers. Qualitative information is the result of value judgements made by those involved with the programs. Both, summative and formative evaluations have a role in this curriculum plan.

This curriculum plan is composed of programs which are tentatively suggested for use at CZA. These programs need further development before actual implementation is feasible. A time line for this development is necessary to facilitate evaluation procedures. This framework should specify what is to be accomplished, identify who is responsible for it, and set dates for the programs to be put in place. Because this curriculum plan is speculative, it is beyond the scope of this paper to establish such a time line. The writer suggests this time line could be developed as part of the teacher workshops. These workshops will need to clarify some of the following evaluation parameters:

Formative Evaluation

<u>Evaluation Question</u>	<u>Evaluation Responsibility</u>
Are instructional objectives consistent with CZA education?	CZA education staff will review and modify.
Are instructional objectives correct for audience needs?	Oral discussion at teacher workshops.
Which activities will be developed by CZA; by teachers?	Oral discussion at teacher workshops.
When will activities be ready for use?	CZA education staff will set a time line.

What procedures exist to keep on schedule and react to changes?

CZA will monitor progress and provide backup support.

Are any activities imperative for pre-site or post-site use?

Oral discussion at teacher workshops.

At what point in a program will the field trip occur?

Oral discussion at teacher workshops.

What forms of data will be collected to evaluate programs?

Evaluation instruments will be adapted by CZA.

How will evaluation instruments be tested?

Selected teachers will pilot test the instruments.

How will activities be reviewed and modified?

CZA education staff will hold regular meetings for this.

How will teachers be made aware of program modifications?

CZA will establish a communication network.

What parameters will be used to justify resource allocation?

CZA will document pertinent resource use.

Summative Evaluation

Evaluation Question

Evaluation Responsibility

What type of research design will be used?

CZA will adopt an appropriate design for this evaluation.

Are there any standard questions teachers will use?

Oral discussion at teacher workshops.

How will program impact on receivers be measured?

Oral discussion at teacher workshops.

How will program impact on teachers be measured?

CZA will adapt an instrument and test it for this purpose.

How will program impact on CZA staff be measured?

CZA will hold regular meetings and compile a synopsis.

Who will analyze data?

CZA administrators will do it.

What standards will be flexible during initial implementation?

CZA administrators will make this determination.

How often will summative reports be prepared?

CZA administrators make this decision.

There are several other types of evaluation questions which need to be formulated. Those listed here are general questions which the two types of evaluations usually address. The importance of establishing these questions before programs are put in place is paramount. The answers to these questions are the standards the programs are expected to uphold. By having the evaluation framework in place before program implementation, it is possible to accurately assess program progress, success, and needed improvement.

Continuous formative evaluation will guide program development. Teachers and CZA staff should work together to develop guidelines for this. The activity sheets used by students at the aquarium are intended to be somewhat universal. Students should have some similar background to facilitate this. Teacher workshops can help to clarify necessary background and suggest overall concepts for inclusion in the activity handouts. Additionally, there may be some questions which teachers could submit to their students in standard classroom tests which can be used as a basis for summative evaluation. These questions could be agreed upon at the teacher workshops.

Summative evaluation based on an appropriate research design can establish the worth of these programs to CZA and its audiences. If accurate data is collected and compiled in respect to the research design, several levels of program impact can be measured. Working with teachers provides an opportunity to illustrate knowledge gains and attitude shifts which are difficult to measure in non-formal educational settings alone.

Evaluation as it has been described, is the most important aspect of this curriculum plan. All of the programs educators can plan are not worth much if an educator cannot show some indication of the program's impact; at least not in the eyes of an administrator with a budget to cut. As mentioned before, new markets exist today, and now more than ever before education is called to prove its value. Proper evaluation procedures can do this and mold a program to meet the needs of these new markets. Evaluation is not a "cure-all", but it is a necessary process which education should not overlook.

The evaluation procedures detailed previously need further refinement as noted. There are many references which provide frameworks for evaluation of educational programs. The writer recommends:

- 1) *Environmental Education Needs Assessment and Evaluation Manual* (Lange 1980) is an excellent book which describes evaluation methods, data collection, and provides example instruments which could be adapted to CZA.
- 2) *Unobtrusive Observation* (Mullins, et al. 1983) describes an evaluation method appropriate for non-formal settings.

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